Pleasant Run Watershed Management Plan

Friends of Pleasant Run
www.pleasantrunwatershed.org

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Acknowledgements

The following deserve sincere thanks for their contributions to this project:

The Steering Committee
Sarah Webb
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Dan Chase
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Executive Summary

The Pleasant Run Watershed Management Plan summarizes data describing the health of Pleasant Run, Bean Creek, and their tributaries, lists pollution sources, and sets goals to protect and restore the streams' water quality. Implementation measures described in the plan include public education and land use practices such as trees, rain gardens, and small wetlands that will improve water quality. Friends of Pleasant Run, an all volunteer group, worked with the public and local groups and government over the course of 18 months on this plan.

Water quality data for Pleasant Run comes from the Indiana Department of Environmental Management (IDEM), Marion County Health Department (MCHD), and Indianapolis Department of Public Works (DPW). All three sets of data show that bacteria is a problem; in fact IDEM has put Pleasant Run and Bean Creek on a list of streams that don't meet Indiana's bacteria standard. MCHD data shows that levels of Dissolved Oxygen (DO), which aquatic life needs to breathe, are low at the beginning of both Pleasant Run and Bean Creek. These measurements are still within acceptable ranges, but their low value, relative to downstream measurements, indicates a need for improvement. Finally, nutrients are a problem in Pleasant Run Watershed. DPW data shows that forms of nitrogen and phosphorus are high along Pleasant Run near 16th Street and near Meridian Street. Along Bean Creek near Garfield Park, a form of phosphorus's level is too high.

IDEM and MCHD also collected data on Benthic Macroinvertebrates—animals without backbones that are big enough to be seen with the naked eye. Benthic Macroinvertebrates live their entire life in the streams, so their presence gives us an idea of how good a habitat the stream provides. MCHD's Macro scores along Bean Creek are 'Fair' to 'Fairly Poor'. Pleasant Run had a wider variety of scores. The most upstream site, at 21st Street scored 'Poor' to 'Very Poor' while further downstream scores ranged from 'Fair' to 'Good'.

Many different sources contribute to the water quality problems we found in the watershed. The Combined Sewer Overflow (CSO) system, which dumps raw sewage into the streams at 55 different points when storms overflow the sewer capacity, contributes bacteria and nutrients. The CSOs are not the only sources of bacteria and nutrients. DPW has identified 15 neighborhoods with leaking septic systems in the watershed, and these also contribute bacteria and nutrients. Both pollutants are also in the animal waste deposited around the watershed's 42 storm water ponds and the edges of the streams. Nutrients from over applied fertilizer also runoff of residential and commercial property. If buffered with vegetation, stream edges can act as filters that keep fertilizer and other pollution out of the water. However, Friends of Pleasant Run found that over 14 of the watershed's 31 stream miles are poorly buffered. A final pollution source is the storm water that comes off of the roofs, streets, driveways, and parking lots in the watershed. Across the watershed, the amount of paved surface in a square block ranges from 40% to 100%. All this impervious surface sends polluted runoff to the streams where it scours the stream channel and erodes the banks. The low Benthic Macroinvertebrate habitat scores are partly due to this extra storm water flowing down Pleasant Run and Bean Creek.

Many of these pollution sources are widespread across Pleasant Run Watershed. Since not every source can be addressed, Friends of Pleasant Run picked 5 critical areas where we felt efforts to improve the watershed would have the most impact.

Critical Area(s)	Reason Area is Critical
Poorly buffered streams and tributaries	Improve Benthic Macro habitat and reduce storm water, nutrients and E. coli
Residential areas, schools, parks and golf courses, and churches	Reduce storm water and infiltrate it into the ground and reduce fertilizer use
Storm water ponds	Reduce bacteria, nutrients, and storm water
Green space overlapping with hydric soils	Protect and/or restore wetland functions
Areas not contributing to the CSOs	E. coli and improve Benthic Macro habitat

Once the critical areas were picked, Friends of Pleasant Run chose water quality improvement goals to work on in those areas. Many of the goals are based on calculations of how much pollution would have to be reduced for the streams to be acceptably clean. These calculations were based on the DPW data and made by a volunteer with experience helping other watershed groups with similar work. The goals are:

Goal 1: Promote and support public participation of efforts that will improve the wildlife habitat and water quality of the Pleasant Run Watershed.

Goal 2: Within 5 years, improve instream habitat so Benthic Macroinvertebrate scores at MCHD sampling sites go up one assessment level from current levels.

Goal 3: IDEM says the recreational season E. coli bacteria load upstream and within the CSO area is 3.06×10^{11} cfu and 5.23×10^{13} cfu respectively. Those loads must be reduced 92% and 99.9% in order to meet the E. coli water quality standard of 125 cfu/100 ml. Our goal is for the entire watershed to meet that standard within 25 years.

Goal 4: The annual load of TKN (a form of nitrogen) is 128,316 lbs. Within 10 years we want to reduce it to 56,254 lbs/year.

Goal 5: Every year, 12,082 lbs of Total Phosphorus runs off the land. Within 10 years we want to reduce it by 30% to 8,457 lbs/year.

Goal 6: Once completed, Indianapolis' Long Term Control Plan will capture 207 million gallons of CSO annually from the Pleasant Run Watershed. Our goal is, within 10 years, to infiltrate 3% of that amount into the ground.

After setting the goals, we brainstormed specific objectives that could be done to achieve them. It became very clear that reducing all the pollution by building or planting water cleansing practices like rain gardens, vegetated ditches, trees, and porous pavement was going to be impossible based on the cost and the enormous number of practices needed to reach the goals. Our list of objectives then, not only includes water cleansing practices but also many public education ideas. The public's understanding of how they contribute to water pollution and what they can do to limit their impact must increase if Pleasant Run's water quality is to improve. The objectives that we prioritized as most important are below:

- Workshops on building your own Rain Barrel or Rain Garden and Open Houses to see residential water quality practices.
- Add terracing to stream channel. Terracing slows the water down, reduces erosion, filters pollution, and increases infiltration.
- Install practices that infiltrate storm water and/or filter runoff. Examples include: Rain Barrels, Rain Gardens, Bioretention, Ditch/Swale Plantings, Green Roofs, Infiltration Devices, and Pervious Pavements.
- Display information in hardware stores explaining where to find items that benefit the watershed. Examples include: Native Plants, Rain Barrels, Downspout Extenders, and Zero Phosphorus Fertilizer.
- Partner with schools on water quality practices and lesson plans on the practice and other relevant topics. Encourage Hoosier Riverwatch monitoring.
- Increase residential awareness of household waste/nutrients entering streams via CSOs and dumping. Encourage use of Toxdrops.
- Plant trees along poorly buffered areas.
- Start a Backyard Habitat program for residential areas along the stream

Friends of Pleasant Run hopes that the community can work towards implementing these objectives and enjoying a cleaner watershed. Implementation can be as simple as addressing runoff pollution at home or working to secure grant funds to pay for larger scale activities. Those interested in learning more about the Pleasant Run Watershed should visit www.pleasantrunwatershed.org.

Preface

This watershed management plan was produced without funding by the Friends of Pleasant Run, a volunteer group formed in 2010. All of the work involved in finishing the plan was done by volunteers, so the plan does have some style differences. The most obvious are the maps and the graphs of water quality data.

The maps were all made using Arc View Geographic Information System (GIS), but three different volunteers, using three different sets of shape files worked on them. The biggest difference between these shape files is a tributary to Pleasant Run that appears on some and is absent on others. This tributary is discussed in detail and field work verified that it is not on the landscape. It may have been placed in a pipe and buried.

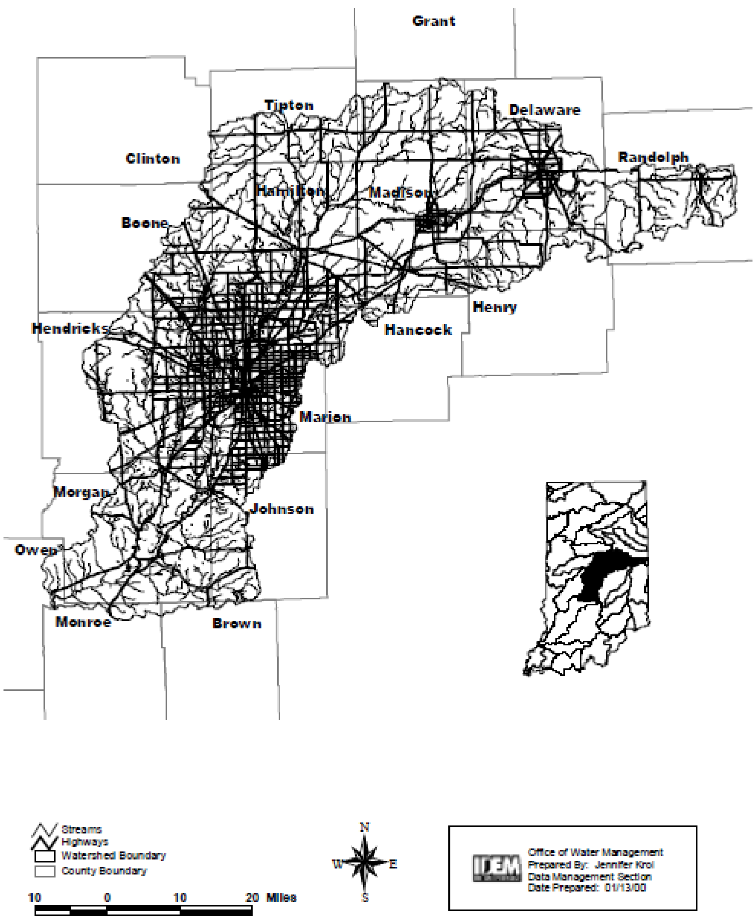
The Project Coordinator and Enviro-Assist LLC each graphed water quality data, and there are style differences between the two sets of graphs. However, these differences don't impact the interpretation of the graphs.

Beginning the Project

Introduction

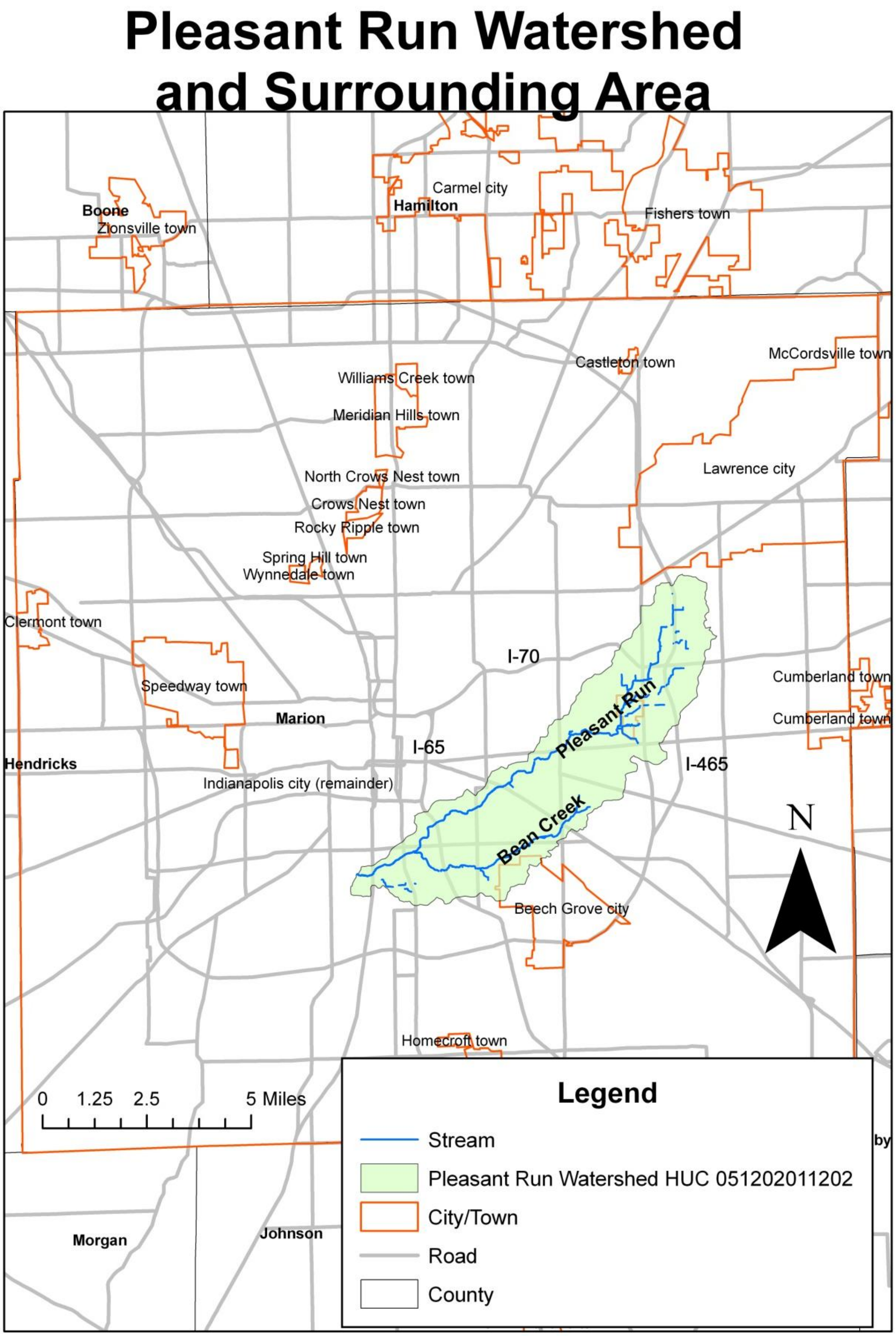
A watershed is all the land that drains to a particular body of water. This watershed management plan outlines goals and objectives to improve the water quality in Pleasant Run and its tributaries. The Pleasant Run Watershed is about 11 miles long and 2 miles wide with a floodplain varying between 200 and 1500 feet wide. Watersheds can be quite large—the Mississippi River Watershed for example—or quite small. For identification purposes, every watershed has been assigned a Hydrologic Unit Code (HUC) by the United States Geological Survey. Pleasant Run's HUC is 051202011202. Large watersheds have smaller watersheds nested within them. The Pleasant Run Watershed is nested within the Upper White River Watershed, which covers approximately 2,271 square miles and parts of 16 counties (Plate 1).

Plate 1: Upper White River Watershed



The Pleasant Run Watershed begins on the east side of Marion County. The county is located in an area that was once a vast swamp. Interestingly, the county is named after the famous General Francis Marion, also known as "Swamp Fox". There were miles of wetlands across the county and much of Indiana as well. In fact, before agriculture began to dominate the Indiana landscape in the 1800's, the state's land cover consisted of 24% wetlands or 5.6 million acres. Now, because of urbanization and agricultural tiles draining the land, much of those wetlands are gone and wetlands cover only about 3.5% of Indiana.

Map 1: Pleasant Run Watershed and Surrounding Area



Credited with being the first inhabitant of Indianapolis, John McCormick settled on the White River in 1820. George Pogue came soon after with his family and occupied an old trapper's cabin near Pogues Run, which is directly north of Pleasant Run. As the Indianapolis population grew, more homes were built, especially along Pleasant Run's rippling clean water. Some of the watershed's earliest settlers, such as the Askren and the Christian family, homesteaded on land along Pleasant Run as early as 1826. The Askren home still sits on the northwest bank of Pleasant Run just north of 16th Street. The Christian home, built in the 1840s, is on Brookville Road. The family raised shorthorn cattle. Christian Park was made possible by a gift to the city from the heirs of the Christian family.

All of the streams in Marion County were prone to flooding and that had a huge impact on the development and planning of the capital city. Early 20th century city planners and park board commissioners had the foresight to mind the beauty and aesthetics of Pleasant Run. Residential sections, park areas, and cemeteries (Anderson Cemetery on 10th Street has markers dating back to 1840) make up most of the development along the banks of Pleasant Run and Bean Creek except for a few factories and commercial buildings. The area along Bean Creek is predominantly residential. The many fine homes along the Pleasant Run Parkway show how a city can be designed on a floodplain and yet retain the beauty of nature.

For all their beauty, Pleasant Run and Bean Creek have fallen victim to the pollution generated by modern living. The "Pleasant Run Organization" was established in 1979 to bring attention to the amount of bacteria in the streams, especially because of the concern for children who typically played in them. The group wanted the stream dredged and widened to better carry all the storm water and sewage that was diverted to it. Now in the 21st century, Indianapolis residents still face the daunting challenge of dealing with sewage overflows and storm water runoff. A newly completed 44 acre basin at Emerson Avenue and I-70 should solve the flooding problems created by Pogues Run for neighborhoods east of I-65 and downtown. The city's Combined Sewer Overflows (CSO) problem, including CSOs along Pleasant Run and Bean Creek, is being solved through a series of underground tunnels designed to store over 54 million gallons of raw sewage before transporting it to the wastewater treatment plant.

The Friends of Pleasant Run supports these initiatives but also wants to work with local government and other partners to limit the amount of polluted storm water runoff reaching Pleasant Run and Bean Creek. Runoff pollution is sometimes called nonpoint source pollution because it does not originate from a single point, like a factory's pipe. In fact, the US Environmental Protection Agency reports that the majority of the nation's water pollution comes from runoff, not from factories and industry.

Runoff is generated when storm water hits impervious surfaces such as parking lots, roofs, and roads and flows off into storm drains and local streams. As Plate 2[1] shows, runoff increases as impervious surfaces cover more and more of a watershed. In fact, research has shown that watershed health begins to decline when impervious surfaces coverage exceeds 10 percent and becomes severely impaired if this number climbs beyond 30 percent of the total watershed area.[2]

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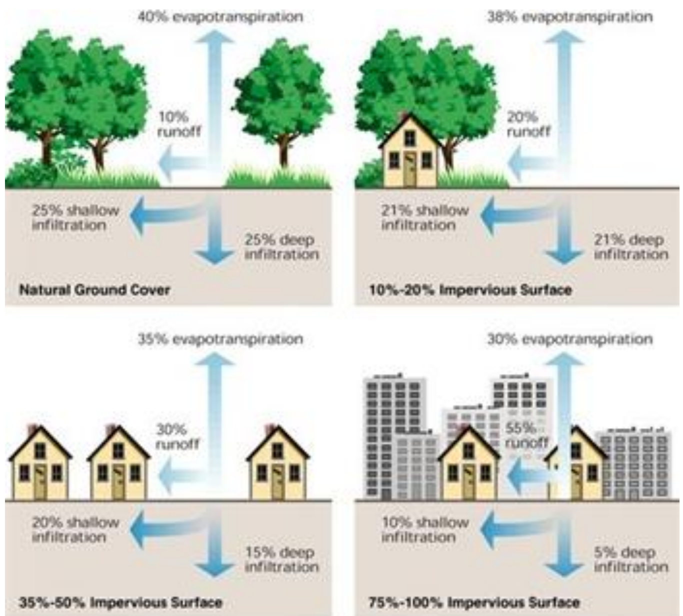
[1] http://www.metroplanning.org/news-events/blog-post/5961

[2] http://www.csc.noaa.gov/alternatives/impervious.html

Plate 2: Runoff's Relationship to Imperviousness



Oils, bacteria, fertilizers, and sediment sitting on impervious surfaces get washed off by storm water and enter Pleasant Run and its tributaries. These pollutants are deposited by normal everyday activities like lawn and garden maintenance, washing cars, and construction. The extra storm water carrying these pollutants can alter the temperature of the stream, damage aquatic habitat, and add sediment to the stream flow by scouring the channel and banks. Storm water is considered a pollutant that harms a watershed's health.

This Watershed Management Plan (WMP) was written to meet the requirements of the Indiana Department of Environmental Management's (IDEM) Section 319 Grant Program and the Department of Natural Resources' (DNR) Lake and River Enhancement Grant Program. Meeting those agency standards allows Friends of Pleasant Run to apply for grant money to improve the watershed. The purpose of the Pleasant Run WMP is to inventory the types and sources of runoff pollution and to set goals and objectives to reduce those sources. The creation of this WMP is not government mandated and participation is voluntary. The Friends of Pleasant Run wrote this plan hoping the community will embrace it and choose to implement its goals.

Watershed Community Initiative

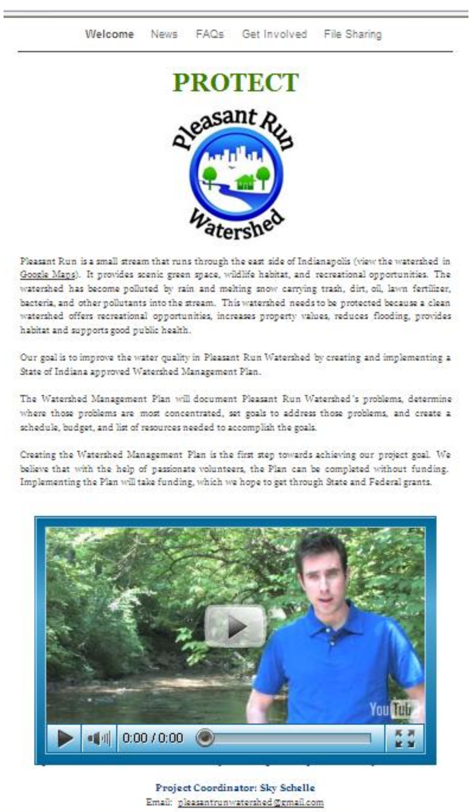
1.1 Reasons for Initiating the Project

The Pleasant Run WMP resulted from the efforts of many different individuals and organizations who shared a desire to improve their local watershed. This project received no funding and has been completely dependent on volunteers. Information for this plan was collected and compiled almost exclusively by average citizens. Many in the community who volunteered did so because they regularly interact with the stream—it flows through several parks and neighborhoods—and see a benefit to improving its water quality. Some of the more technical work was done by environmental consulting firms who felt that their pro bono assistance aligned with their goal of assisting the local community.

1.2 The Steering Committee

The Project Coordinator had the initial vision for this project, but realized a steering committee and core of volunteers would be needed in order for the plan to have community support. Between November of 2009 and February 2010, the Coordinator collected contact information for organizations, businesses, neighborhood groups, churches, and individuals across the watershed. Between February and June 2010, through email, mailed flyers (Appendix A), and attending neighborhood meetings across the watershed, the Coordinator worked to sell the idea of watershed management to the community. A press release (Appendix B) was published by four Indianapolis media outlets and helped generate public interest in the project. Early project volunteers helped the outreach effort by creating a project website (www.pleasantrunwatershed.org) and creating a video introducing the project, which was placed on the website.

Plate 3: Project Website Front Page



The outreach effort culminated on June 22, 2010, in a project kickoff meeting attended by 40 people. At the meeting, the Coordinator introduced the concepts of watershed management, explained why Pleasant Run was polluted, collected public concerns about the watershed, and asked those in attendance for assistance in writing a watershed management plan.

Plate 4: Project Kickoff Meeting

Due to the outreach effort, 45 individuals signed up to help with the project. Some of these individuals were more involved than others, but everyone who volunteered their time made a contribution to the project. The June 22, 2010, meeting also led to citizens volunteering for the steering committee.

Figure 1: Pleasant Run Steering Committee

Name	Affiliation
Chris Barnett	Watershed Resident
Kent Moore	Watershed Resident
Kathleen Hagan	Watershed Resident (works for IDEM)
Elizabeth Garber	Watershed Resident
Sky Schelle	Watershed Resident
Sarah Webb	Mundell & Associates (located in the watershed)
Pradnya Sawant	Mundell & Associates
Angela Sturdevant	Watershed Resident (works for The Nature Conservancy)
Dick Dammeyer	Watershed Resident

1.3 Stakeholder Concerns

During the June 22, 2010, project kickoff meeting, the public was asked what concerns and questions they had about the Pleasant Run Watershed. Each concern or question was written down and at the end of the meeting everyone was asked to designate which three were most important to them. This voting was done to provide the steering committee with an early idea of the priorities the public wanted them to focus on.

Plate 5: Writing Down Concerns

One of the goals at the first steering committee meeting was to finalize the list of concerns so the Watershed Inventory could begin. The committee reviewed the concerns from the public meeting, discussed any questions or confusion about them, and talked in general about what kind of efforts they thought might improve the watershed and used those ideas to further flesh out the concerns and give more direction to the Project Coordinator. For example, one member suggested promoting zero phosphorus fertilizer. The committee then researched information about the availability of zero phosphorus fertilizer during the Watershed Inventory.

Figure 2: Final List of Concerns/Issues/Questions

Effect of golf course chemicals on water quality	Salt from Interstate 465 and 70 interchange	Where are the State Impaired sections of the stream?
Citizens Gas property: legacy pollutants, runoff to Pleasant Run, question of whether groundwater seepage is still being treated	Do any of the schools in the watershed do Hoosier Riverwatch?	Lack of education about local water quality
Hawthorn Rail yards: possibility of PCBs and other legacy pollutants onsite	Recreational safety (E. coli impairment): where do kids play in stream?	People need to know how to improve water quality through actions they can take at home
Lack of wildlife along stream corridor and in stream	Additional water testing in certain neighborhoods may be needed	Need for water conservation for drinking water purposes
Runoff at Foundry (Sherman Avenue and Washington Street)	Number of storm water ponds and their impact on water quality	Log jams behind bridges
Reducing runoff from new construction	Algae and foam in stream at 10th Street and Arlington Avenue	Pooling behind log jams invites mosquitoes
Overall need to reduce storm water	Combined Sewer Overflows	General debris in stream (need for cleanup)
Runoff at Harvester Parking lot on Brookville Road	The need for more downspout disconnects to reduce residential runoff	Where can the public buy zero phosphorus lawn fertilizer?
Invasive removal in Garfield Park at Lily Day of Service (invasives quickly came back)	Illegal dumping (solids, oil, leaves) in the watershed and in storm sewers	Where are septic systems located in the watershed?
Questions about the necessity and impact of dams at Shadeland Ave and at Prospect Street	Are there regulated drains in Marion County? Who is in charge of ditch maintenance?	Landowners need to know what to do with standing water (besides channeling it away)
Crime in riparian area near Shelby Street and Keystone Avenue	Bean Creek is buried near Harvester site? (possible daylighting project)	Bank erosion in watershed (i.e. at Keystone and Pleasant Run)
Invasive plants throughout the watershed	Roadside ditches are eroding	Lack of buffer along steam banks

Watershed Inventory

Watershed Inventory Part 1

2. 1 Introduction to Watershed Inventory Part 1

The purpose of the Watershed Inventory is to gather information about the concerns, issues, and questions gathered from the public and the steering committee and use it to characterize the watershed. Data was collected by direct observation, online research, and through phone calls and meetings. Once collected, the steering committee studied the data to determine which of the concerns, issues, and questions they would focus on (see Chapter 4 for more information on those decisions).

Part 1 of the Watershed Inventory presents data on the scale of the entire watershed. Part 2 (Chapter 3) of the Watershed Inventory takes a more focused look at parts of the watershed and data that is specific only to those parts.

2.2 Geology/Topography

Pleasant Run Watershed is underlain by limestone, dolomite, siltstone, and shale of Silurian, Devonian, and Mississippian ages. The soils are loams and silt/loams that formed from glacial deposits left from the Wisconsin Glacier, which reached its maximum extent 18,000 years ago. These deposits range in thickness from 100 to 250 feet, except immediately near the White River where they may be less than 50 feet thick.

The Tipton Till Plain, which is rolling to gently rolling, covers the watershed. The beginning of the Pleasant Run Watershed, also known as the headwaters, is just north of the Interstate 465 and Interstate 70 junction on Indianapolis' eastside. The elevation at the headwaters is 876 feet. From the headwaters, Pleasant Run flows southwest until it enters the White River, just south of downtown Indianapolis. During this trip, the stream's elevation drops 201 feet. A groundwater aquifer tapped by several private wells underlies the watershed. The entire watershed is on city water and none of the wells serve a community of people as defined by IDEM, hence there isn't a drinking water protection area within the Pleasant Run Watershed. Since the water in Pleasant Run Watershed is not used as a drinking water source, water conservation, which was a public concern, is not thought to be a need.

2.3 Hydrology

The GIS shape file used by the Coordinator for this project lists 47 acres of open water and 54 waterbodies in the watershed.

Plate 6: Popular Point of Access to Pleasant Run

These waterbodies are a combination of small lakes or ponds, wetlands, and storm water ponds. Pleasant Run, Bean Creek, and their tributaries run for approximately 31 miles (see Map 1). Many of those miles pass through city parks and the Indy Parks Greenways, providing ample opportunity for the public to come in contact with the stream. Public safety due to bacteria in the streams is a stakeholder concern.

As part of an Indianapolis Department of Public Works report[3], 100 people recreating, living, or working near streams in Marion County

[3] DPW, Cost Estimating Procedures for Raw Sewage Overflow Control Program, April 23, 2004

affected by combined sewer overflows were personally interviewed in 2002. The results for Pleasant Run showed that:

1. 82% use the stream for walking, jogging, or biking.

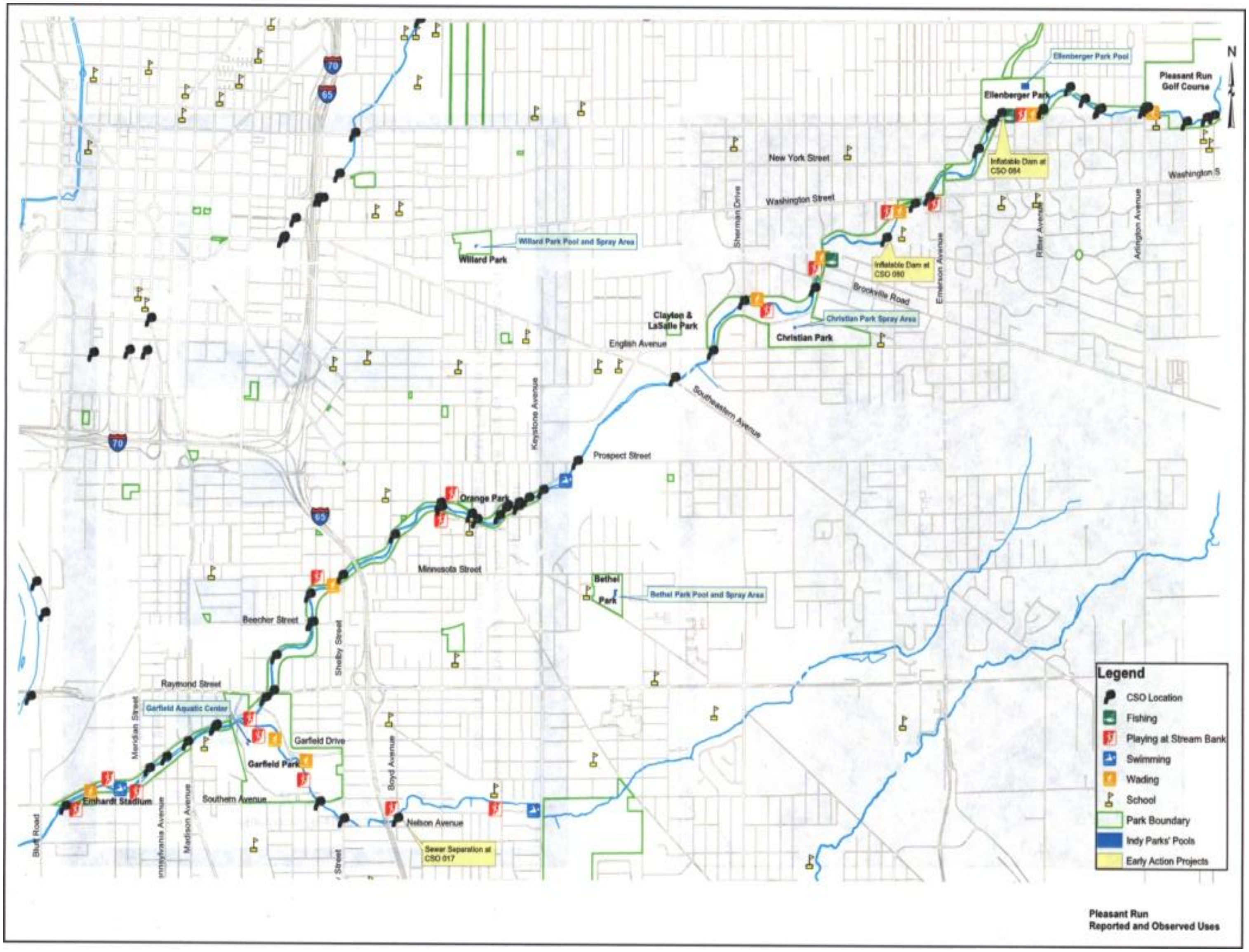
2. 47% report that they or a member of their family comes in contact with Pleasant Run every week.

3. 73% have seen others playing at the stream bank.

4. 66% have seen children or adults playing in the stream during or within 24 hours after a rainfall.

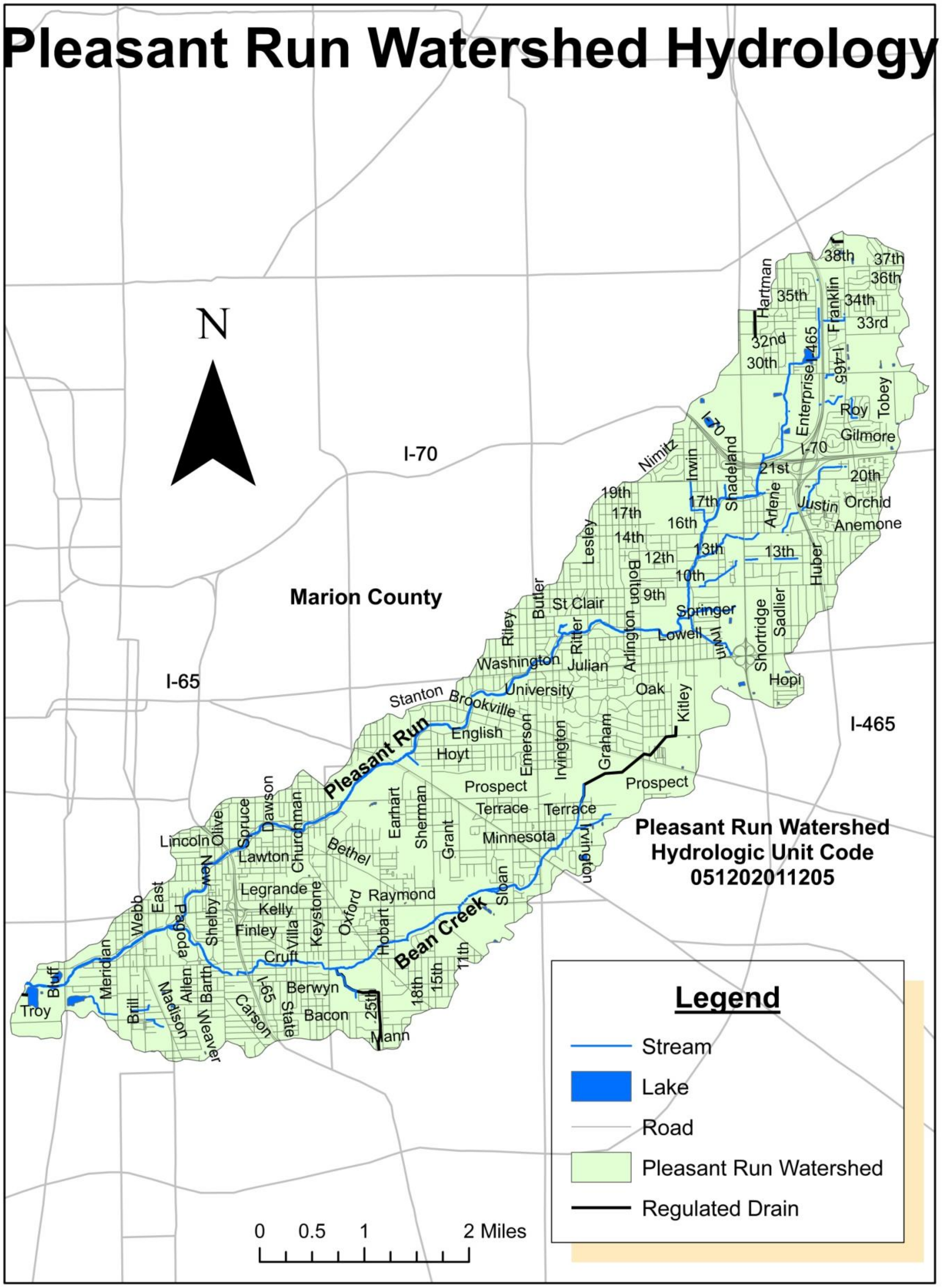
Plate 7 from the DPW report shows the location in which the public comes in contact with the streams. Information collected in 2010 at neighborhood group meetings show that these sites are still being used, despite public education about the bacteria within the waters. As their budget allows, Indy Parks is installing splash parks to offer children water recreation without getting in the streams.

Plate 7: Reported Observations from Stream Reach Characterization and Evaluation Report-2003


Ellenberger Park Pool
Pleasant Run Golf Course
Ellenberger Park
Inflatable Dam at CSO 084
New York Street
Washington Street
Willard Park Pool and Spray Area
Willard Park
Inflatable Dam at CSO 080
Brookville Road
Christian Park Spray Area
Christian Park
Clayton & LaSalle Park
English Avenue
Southeastern Avenue
Prospect Street
Keystone Avenue
Orange Park
Minnesota Street
Bethel Park
Bethel Park Pool and Spray Area
Beecher Street
Shelby Street
Raymond Street
Garfield Aquatic Center
Garfield Drive
Garfield Park
Emhardt Stadium
Southern Avenue
Boyd Avenue
Nelson Avenue
Sewer Separation at CSO 017
Meridian Street
Madison Avenue
Bluff Road
Sherman Drive
Emerson Avenue
Ritter Avenue
Arlington Avenue
Legend
CSO Location
Fishing
Playing at Stream Bank
Swimming
Wading
School
Park Boundary
Indy Parks' Pools
Early Action Projects
Pleasant Run
Reported and Observed Uses

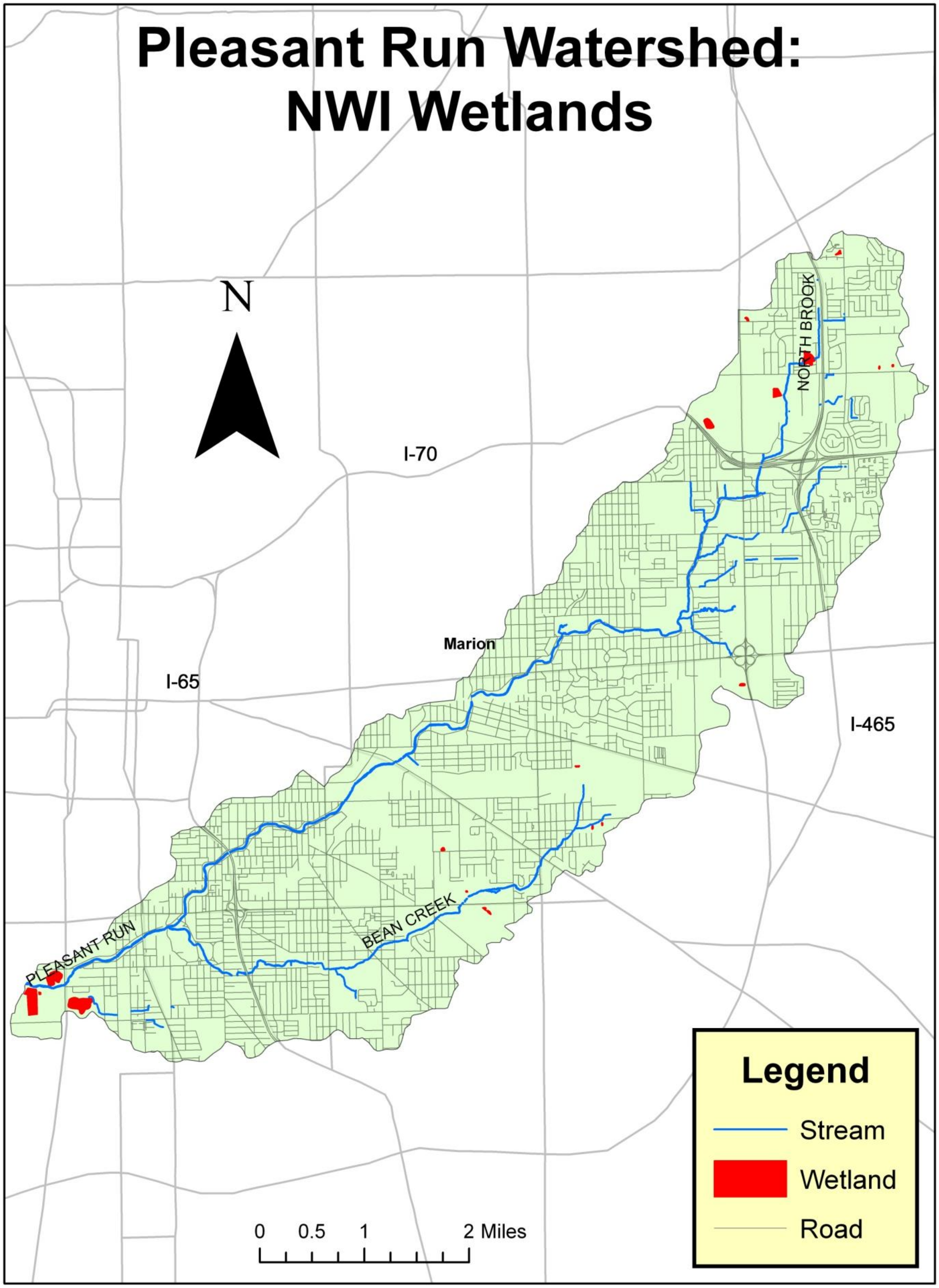
The hydrologic features of Pleasant Run Watershed were highly modified as the area became more and more urbanized. Original settlers and subsequent generations dug ditches, modified stream banks, installed at least two dams, drained acres of wetlands, urbanized the watershed, and made other hydrologic modifications. These modifications are shown on Maps 3 and 4.

Map 2: Pleasant Run Hydrology



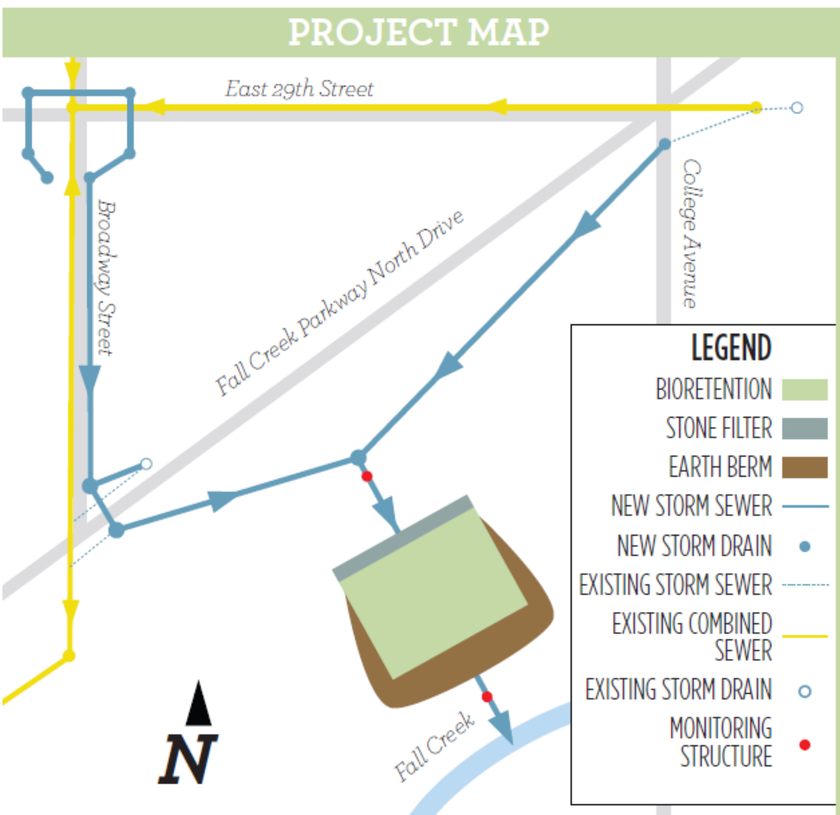
2.3.1 Wetlands

Map 3: Pleasant Run Wetlands



Wetlands play an important role in reducing regional flooding, providing wildlife habitat, and filtering sediment, nutrients, and other pollutants. While 14.7% of the watershed's soils are hydric soils that can support wetlands, (see Section 2.4 and Map 7), the National Wetland Inventory (NWI)—a United States Fish and Wildlife Service program that inventories and maps the nation's wetlands—shows only 17 small wetlands within the Pleasant Run Watershed (see Map 3). These wetlands make up only 0.43% (61.7 acres) of the watershed. The NWI inventory is made through observing aerial photography and is subject to mistakes. A Friends of Pleasant Run volunteer, who works as a wetland scientist, investigated all but two of the National Wetland Inventory wetlands and in her best professional judgment reports that none of them are actual wetlands. Many are storm water ponds or excavated ponds. Her report, which is in Appendix C, does identify some small areas which are wetlands and other areas which very well may be wetlands.[4] These will be discussed in the Watershed Inventory Part 2. The remaining two NWI wetlands were visited by the Project Coordinator: one was a storm water pond and the other was a grassy lawn. As discussed in Section 2.5, existing landuse in the watershed will impede most efforts to restore wetlands. However, opportunity to add wetland type practices called bioretention may exist. As seen in Plate 8, Indianapolis has installed these practices along other area streams.

Plate 8: Bioretention Cell Along Fall Creek[5]



The bioretention cell in Plate 8 collects storm water into a semi-natural area that filters and infiltrates it into the ground rather than releasing it untreated into Fall Creek. If similar practices could be added to Pleasant Run Watershed, they would help address the following stakeholder concerns: Lack of wildlife along stream corridor and in stream, bank erosion in watershed, the need to reduce storm water, and a lack of buffers along streams. Existing agreements between Indy Parks and the Indiana Department of Transportation will make it difficult to add bioretention or other practices along the Indy Parks Greenways, so these practices would likely need to be installed on private land.

2.3.2 Regulated Drains

A regulated drain is a surface water channel which a municipality assesses a fee from adjacent property owners to fund the maintenance of the drain (see Map 4). Typically the maintenance involves clearing the channel of sediment, log jams, or other debris that may impede the flow of water. Regulated drains are an important tool in agricultural watersheds where efficient drainage is important to the landowners. Hartman-Schimer drain runs approximately 2 miles in the Bean Creek headwaters, but only the last 0.25 miles is on the surface. The majority of the drain is underground and runs underneath a neighborhood and the parking lot of a Navistar Factory (see Plate 9). Christian-Kerkhoff drain flows just over a mile through Sarah Shank golf course where it connects with Bean Creek. The drain actually originates outside Pleasant Run Watershed; an example of how intense

[4] Elizabeth Pelloso December 4, 2010

[5] http://www.indygov.org/eGov/City/DPW/Environment/CleanStream/Projects/Documents/Fall%20Creek%20Pilot%20Project%20Fact%20Sheet_06-25-09.pdf

urbanization and hydromodification has altered the traditional watershed boundaries. Although Indianapolis defines all these drains as ‘regulated’, they are not regularly maintained nor are fees collected from landowners.

Plate 9: Indianapolis GIS Viewer image of Hartman-Schimer regulated drain

2.3.3 Dams

In the upper reaches of Pleasant Run, just upstream of where the stream goes under Shadeland Avenue lies a concrete dam. What, if any, effects the dam has on water quality or wildlife are unknown. The dam does create a small impoundment, known on Indianapolis' eastside as Shirley Lake. A member of the Friends of Pleasant Run steering committee remembers playing hockey on Shirley Lake when it froze in the winter. A second dam sits south of Shelby Street, just downstream of the old Coke Plant. The dam is in disrepair. Neither the City of Indianapolis nor the Indiana Department of Natural Resources has information about these dams, so their origin, owner, and intended purposes are mysteries.

Plate 10: 'Shirley Lake' Dam and Shelby Street Dam

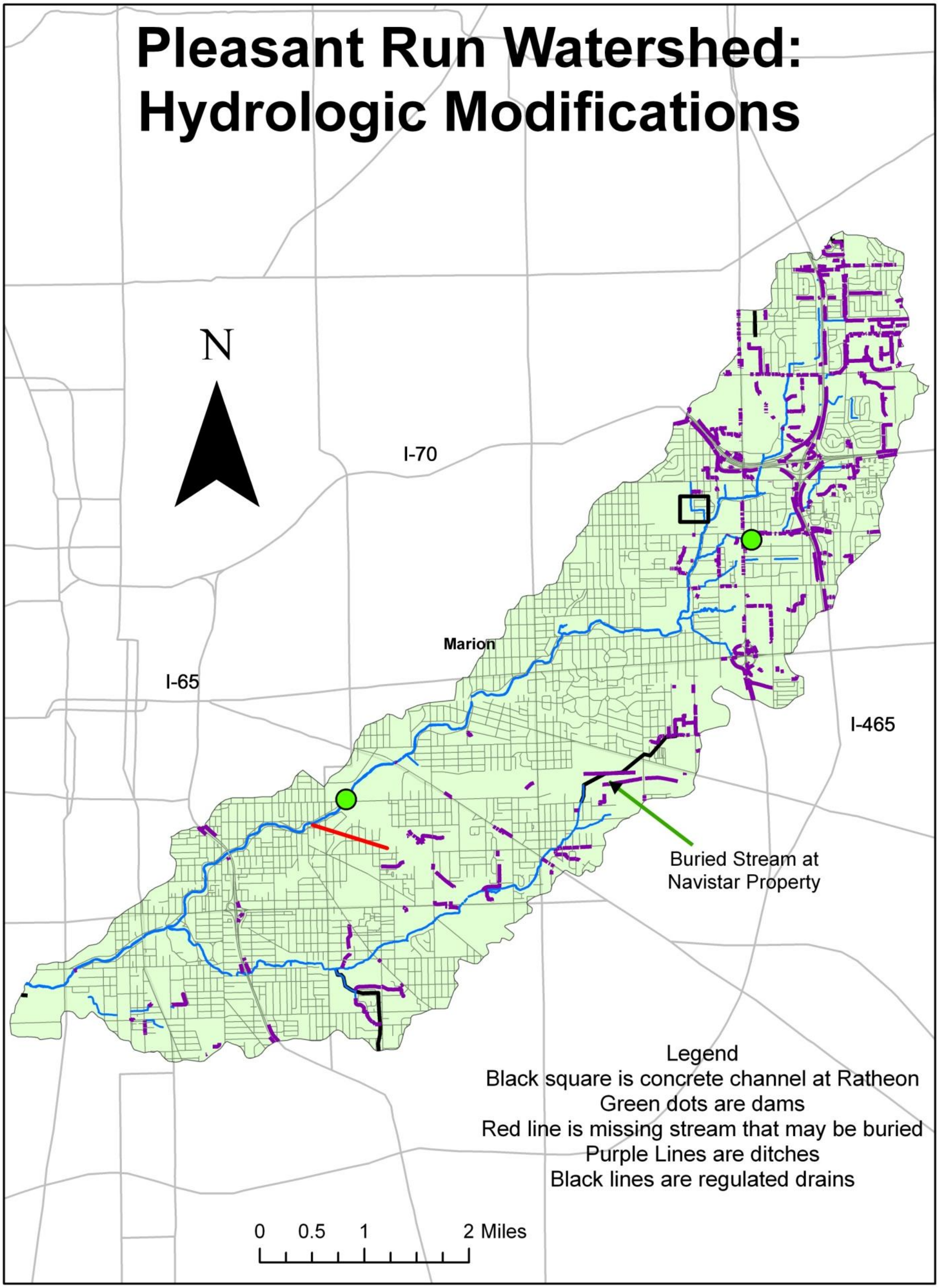
2.3.4 Channel Modifications and Ditches

A channel modification (see Map 4) exists in the Pleasant Run headwaters on the Raytheon Property and an adjacent neighborhood. A small tributary of Pleasant Run's has been placed in a concrete channel. The channel efficiently moves water, but it is not ideal for supporting biotic communities. Further south in the watershed, near Bethel Park, yet another small tributary has been modified. On some GIS shapefiles, this tributary can be seen crossing Keystone Avenue and joining Pleasant Run, while on other shapefiles the tributary is not shown. In reality, there is no stream on the surface matching the location of this tributary, however, there is a pipe emptying into Pleasant Run at the point where maps says the two streams meet. Neither the Indianapolis Department of Public Works nor Indy Parks has information about this 'missing stream'. Possibly the stream has been placed in a pipe and buried.

Plate 11: Roadside Drainage Ditch

A final hydrologic modification of the watershed is the 39 miles of roadside drainage ditches (see Map 4). Primarily found in the headwaters of Pleasant Run and Bean Creek, these ditches coincide with hydric soils—soils suitable for wetlands and hence not typically well drained—and line many of the major roads. These ditches were identified as a stakeholder concern because many are eroding and adding sediment to the streams, and because they represent a failure—and perhaps an opportunity—to hold storm water on the landscape and give it a chance to infiltrate into the ground.

Map 4: Hydrologic Modifications

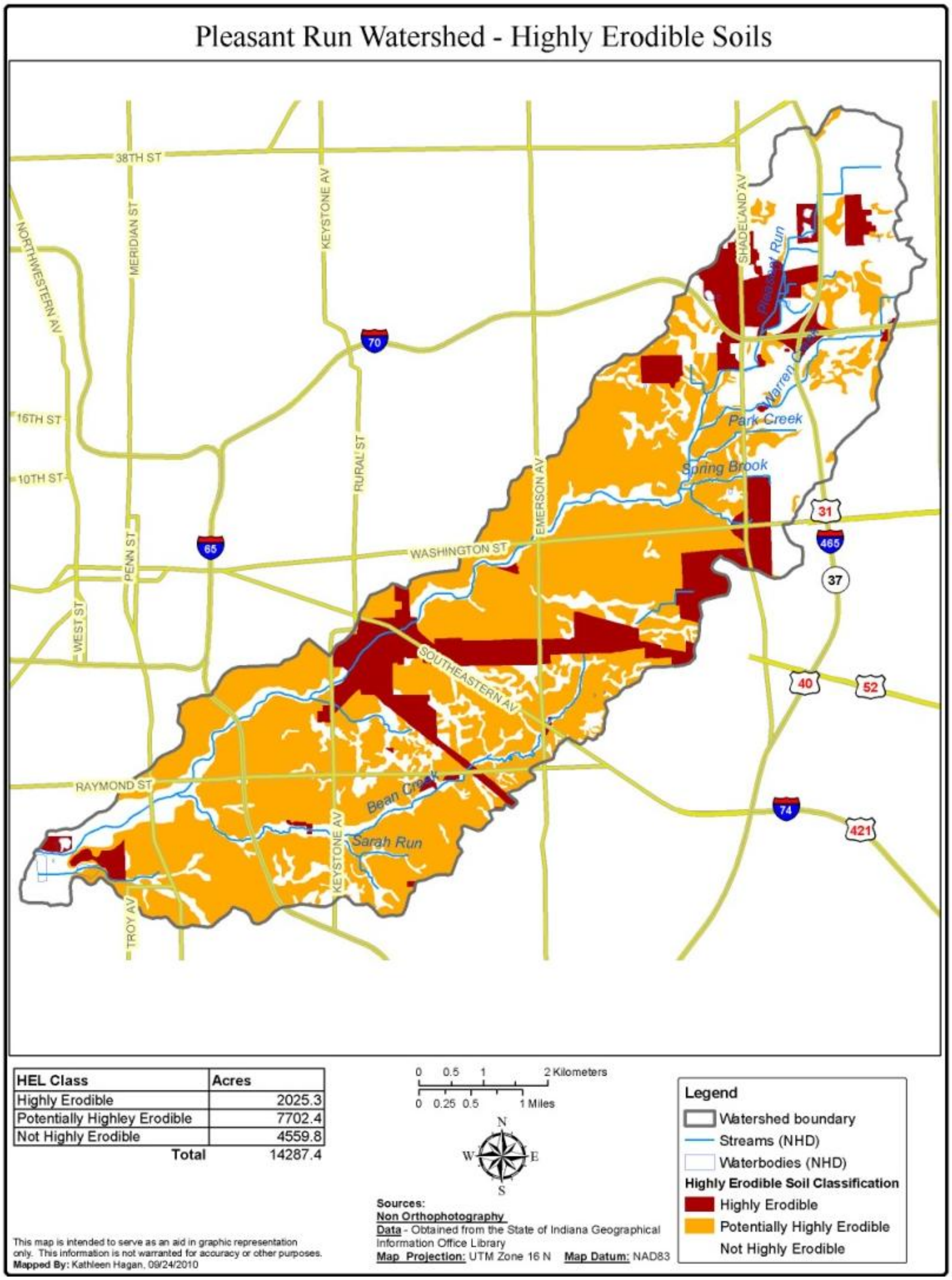


2.4 Highly erodible soil, hydric soil, and septic system suitability

Eroding soils contribute sediment and nutrients attached to that sediment to local streams. The erosion of soil relates to three stakeholder concerns: bank erosion, erosion from construction sites, and eroding roadside ditches.

2.4.1 Highly Erodible Soil

Map 5: Pleasant Run Watershed – Highly Erodible Soils



HEL Class	Acres
Highly Erodible	2025.3
Potentially Highley Erodible	7702.4
Not Highly Erodible	4559.8
Total	14287.4

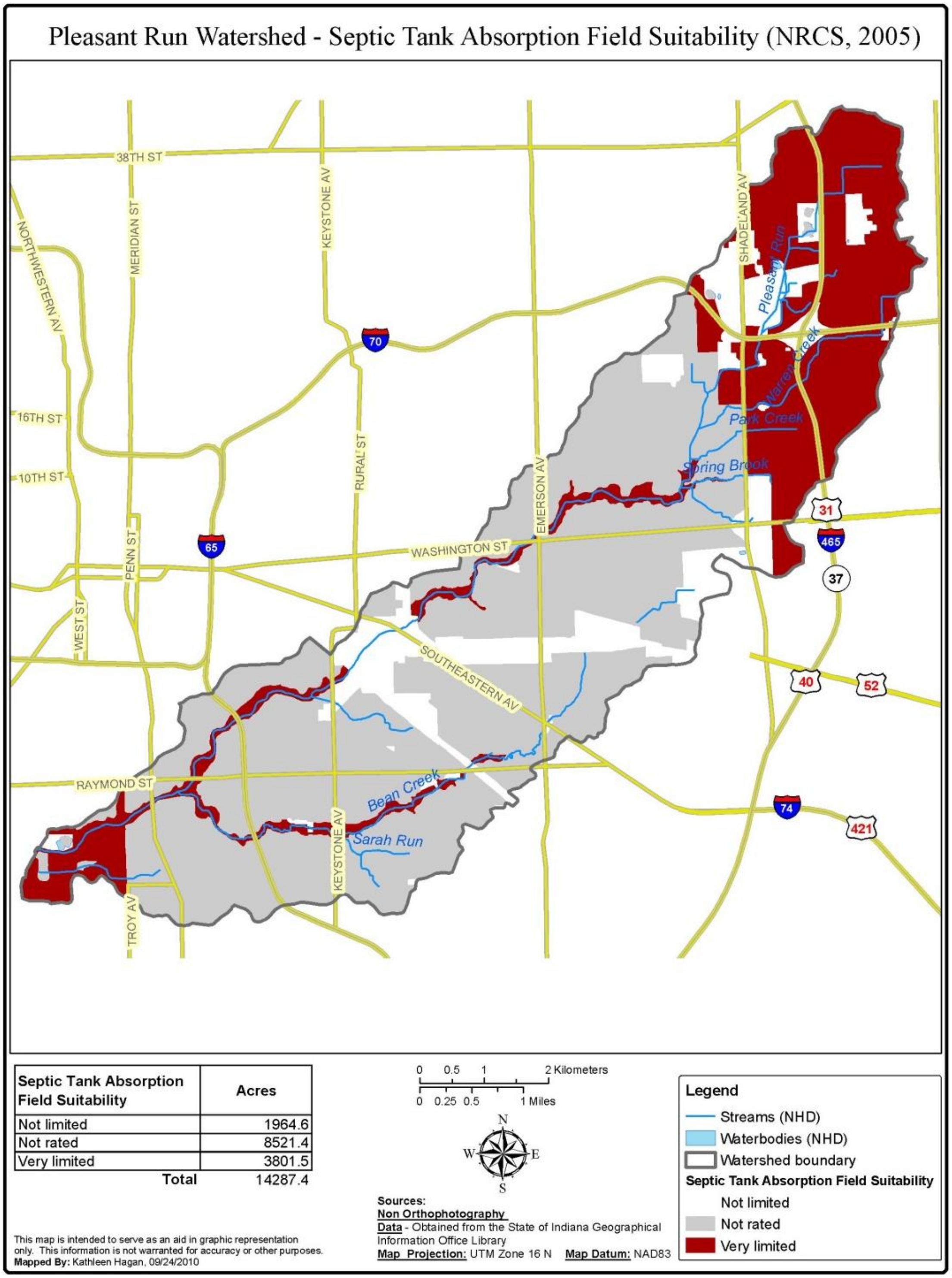
The Natural Resources Conservation Service (NRCS) maintains a list of highly erodible soil units for each county based upon the potential of soil units to erode from the land. The classification is based upon an erodibility index for a soil, which is determined by dividing the potential average annual rate of erosion by the soil unit's soil loss tolerance (T) value, the maximum annual rate of erosion that could occur without causing a decline in long-term productivity. Potentially highly erodible soils may or may not be highly erodible depending upon factors such as slope steepness and length. A field investigation would be necessary to determine whether or not potentially highly erodible lands are in fact highly erodible.[6] 68% of the soils in the Pleasant Run Watershed are classified as highly erodible or potentially highly erodible. The one area where natural soil erosion likely is not an issue is the headwaters of Pleasant Run. Many of the eroding roadside ditches are in the headwaters, suggesting that ditch erosion is driven by storm water and not soil properties.

2.4.2 Septic System Suitability

Onsite sewage disposal (septic) systems are designed for the purpose of wastewater treatment. For optimal functionality, the systems must be properly engineered and installed, located in suitable soils, and receive routine maintenance. Systems that are not regularly maintained, have outdated or inefficient designs, or are installed in inappropriate soils often result in septic failure. Over 60% of the soils in the Pleasant Run Watershed are unrated for septic suitability. 27% of the soils are rated very limited for septic suitability. Discharge of effluent associated with failing septic systems can introduce pathogens, parasites, bacteria, and viruses, which can cause disease through body contact or ingestion of contaminated water. E. coli and other pathogens pose a particular threat when sewage pools on soil or migrates to recreational waters. Septic systems and their contribution to bacteria and nutrient pollution concerns the Pleasant Run stakeholders. Information about septic system locations and Indianapolis' plans to eliminate those systems is below in Section 2.6.

[6] HEL and Septic Suitability text adapted from Save the Dunes' Salt Creek Watershed Management Plan

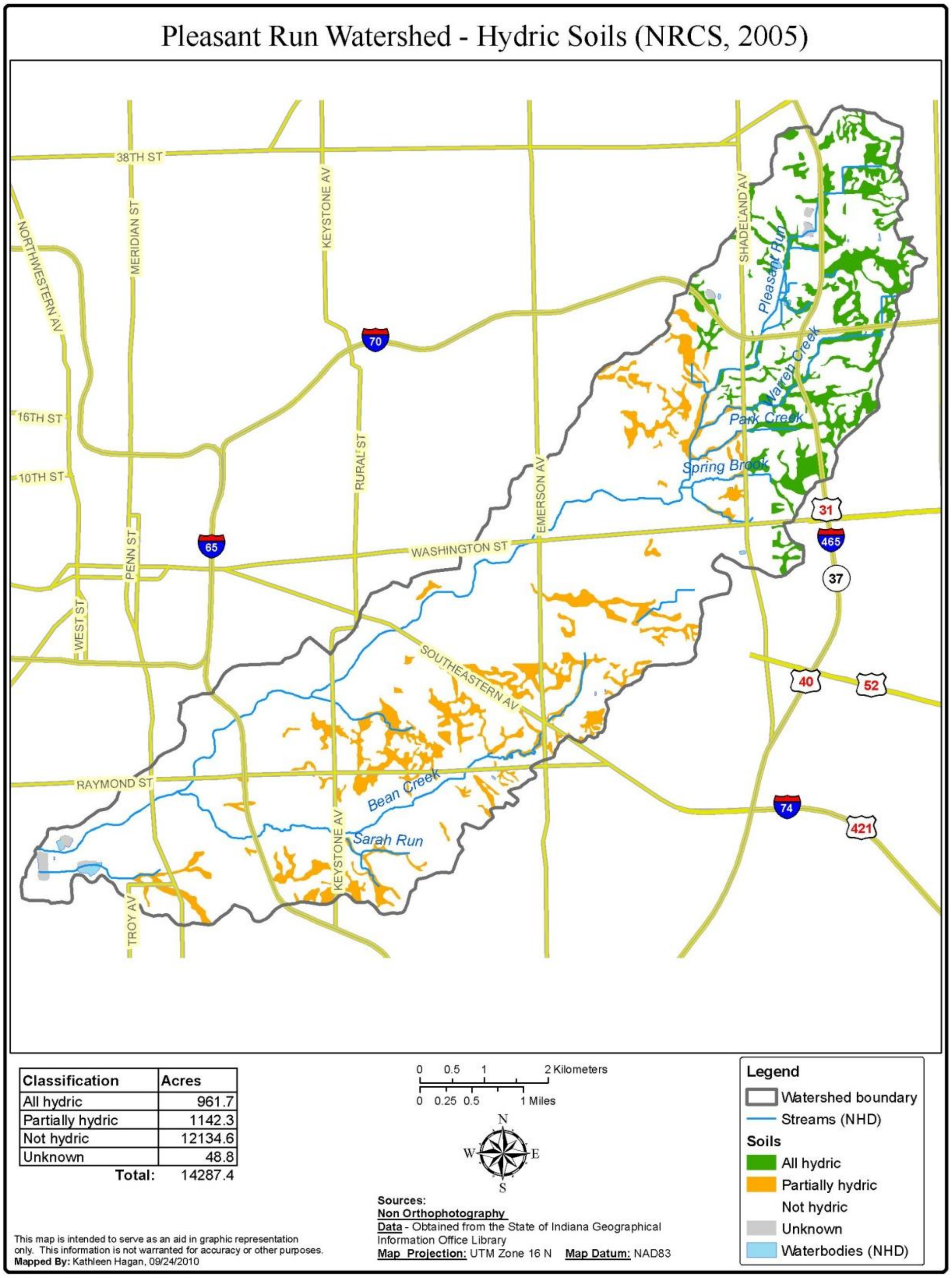
Map 6: Pleasant Run Watershed – Septic Tank Absorption Field Suitability



2.4.3 Hydric Soils

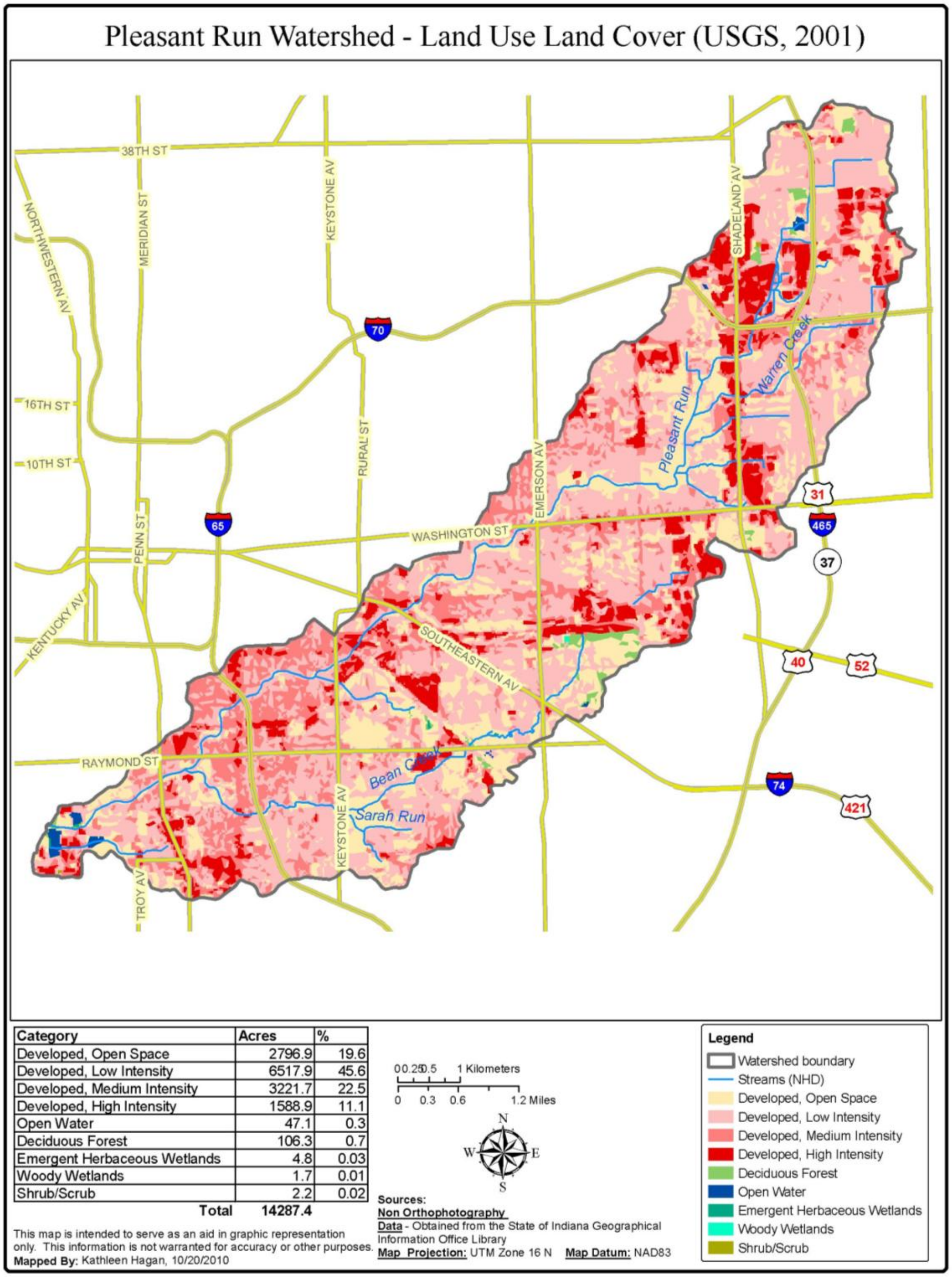
A hydric soil is a soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Hydric soils support the growth and regeneration of water tolerant vegetation and are associated with wetlands. As shown on Map 7, 15% of Pleasant Run Watershed's soils have some capability to support a wetland environment. Note on Map 7 that the 'all hydric soils' are completely within the watershed's headwaters. As Map 3 shows, the wetlands historically associated with these soils—and their ability to slow and filter storm water—are gone. Due to the shortage of areas where undeveloped land overlaps with hydric soil, increasing wetlands will be difficult.

Map 7: Pleasant Run Watershed – Hydric Soils



2.5 Landuse in the Watershed

Map 8: Pleasant Run Watershed – Land Use Land Cover



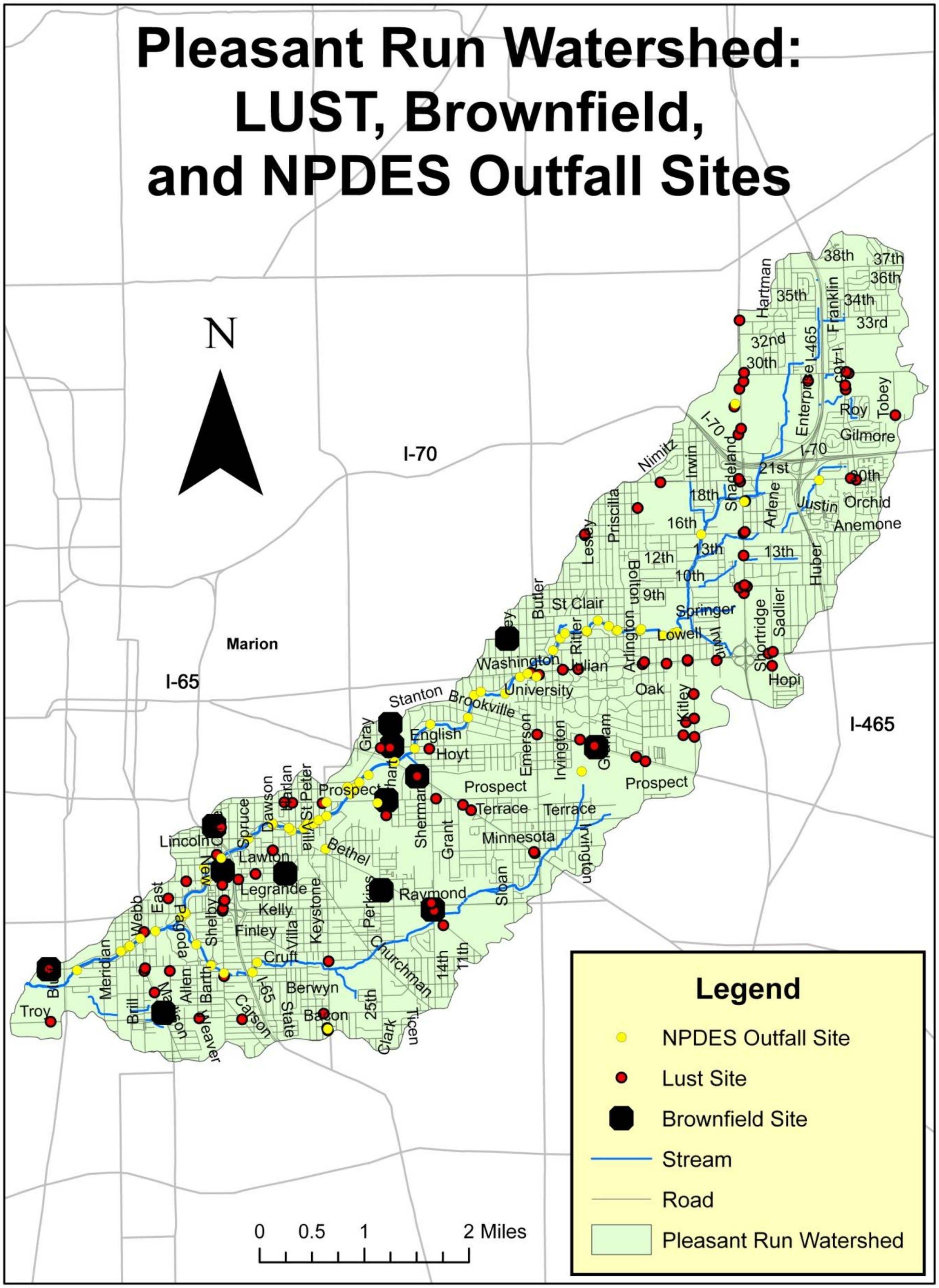
Pleasant Run Watershed sits within Marion County. Except for less than a square mile of the City of Beech Grove, the entire watershed is part of the City of Indianapolis. The Beech Grove portion is residential and on the south bank of Bean Creek. The watershed is fully urbanized and is not undergoing large landuse changes, nor are large tracts of land available to restore wetlands and other native areas. Map 8 details the different types of landuse in the Pleasant Run Watershed.

79% of the watershed is either Low, Medium, or High Intensity Development. While not all this land is impervious—lawns and other grassy areas must be taken into account—storm water will runoff of a significant amount of land. Low Intensity Development makes up over 45% of the Pleasant Run Watershed's landuse and represents the residential neighborhoods that are spread across the entire watershed. The majority of these neighborhoods could be described as middle class. While a small amount of new housing has gone up near Beech Grove, the vast majority of housing is decades old. Some neighborhoods, including Irvington and Fountain Square have 19th century structures. Medium or High Intensity Development, indicative of commercial space, warehouses, and industry, makes up 33% of the watershed. The changing economy and the economic downturn reduced the amount of industry in the watershed; as witnessed by the 2007 Coke and Gas Plant closing and the 2010 Ford Factory closing. There are certainly still some industrial practices. For example, the watershed has several Leaking Underground Storage Tanks (LUSTs), facilities permitted to discharge effluent into the streams (known as National Pollutant Discharge Elimination System (NPDES)), as well as Brownfields, which are industrial sites in need of clean up and reuse. LUSTs, NPDES facilities, and Brownfields were not listed as a concern, but they are a feature of the watershed and so are mapped on Map 9. Figure 3 has information about the NPDES facilities.

Figure 3: NPDES Facilities

Active NPDES Facility Addresses	**Facility Type**	**NPDES Violations**
3102 S. Keystone	Gas Station	None
2322 E. Minnesota	Food Manufacturer	2008 (monitoring/reporting) 2008-10 (temperature of effluent)
2950 Prospect	Gas Production and/or Distribution (Coke Plant)	None; but did violate the Clean Air Act
5565 Brookville Road	Iron Foundry (Harvester Plant)	2009 (monitoring/reporting) 2008-10 (chlorine-total residual- in effluent)
5103 E. Washington	Gas Station	2009 (Benzene and pH)
1855 N. Shadeland	Gas Production and/or Distribution	Unknown, site not in EPA database
2900 N. Shadeland	Car Dealership	2010 (monitoring/reporting)

Map 9: Pleasant Run Watershed: NPDES, LUST, and Brownfields



Another High Intensity area is the Interstate Highways. Interstates 65, 70, and 465 all cross the watershed, and the three major interchanges each have commercial property surrounding them. Chlorides applied in the winter to melt highway ice runs off into area streams (see Section 3.2) and storm water moving off the highways year round potentially can transport other pollutants and cause erosion.

2.5.1 Indy Parks

Developed Open Spaces make up 19.6% of Pleasant Run Watershed. This category includes parks and the Indy Parks Greenways.

Plate 12: Christian Park

Figure 4 shows the parks Indianapolis maintains in the Pleasant Run Watershed.

Figure 4: City Parks

Park Name	Acreage in Watershed	Acreage
38th & Franklin Park	4.75	11.78
Bethel Park	14.51	
Christian Park	73.15	
Clayton & LaSalle Park	3.78	
Dubarry Park	8.97	26.92
E 21st St Parcel	8.2	
Ellenberger Park	37.4	
Finch Park	0.89	
Garfield Park	122.91	
Greene Park	10.25	
Hendricks Park	0.72	3.01
Irvington Circle	0.67	
Pride Park	0.5	
Ringgold Park	0.21	
Sandorf Park	6.41	
Sexson Park	0.57	
Windsor Village Park	2.1	6.38
sub-total	**295.99**	
Golf Course	Acreage	
Pleasant Run	102.8	
Sarah Shank	118.23	
sub-total	**221.03**	
Greenways	Acreage	
Pleasant Run	131.54	
Brown's Corner	3.33	
Orange Park	1.07	
Emhardt Park	2.11	
Prospect Falls Park	0.29	
sub-total	**138.34**	
TOTAL	**655.36**	

Pleasant Run Trail is part of the Indy Parks Greenways. There are several Greenways across Indianapolis and the city plans to connect them over time. The Pleasant Run Greenway is open land, much of it covered with trees and bushes, that borders

Plate 13: Pleasant Run Greenway

Pleasant Run roughly from Ellenberger to Garfield Parks. The Greenway is a 6.9 mile trail that begins at Ellenberger Park, connects to Christian Park and ends at Garfield Park, near the intersection of Raymond Street and Pleasant Run Parkway. The greenway meanders along Pleasant Run offering a paved route for walking, bicycling, and rollerblading. The Pleasant Run Greenway connects recreation facilities such as the Kin Hubbard Memorial and Garfield Park & Conservatory. Another part of the Indy Parks Greenways, the Pennsy Rail-Trail, is a 1.2 mile bike/walking path between Arlington Avenue and Shortridge Road that opened in the fall of 2009. Eventually the Pennsy Trail will connect to the Town of Cumberland, just east of Indianapolis. Other future connections include Pleasant Run Greenway, Ellenberger Park, Grassy Creek Greenway, Buck Creek Greenway, Washington Square Mall, and downtown Indianapolis.[7]

2.5.2 Construction Site Erosion

Despite the fact that the Pleasant Run Watershed is fully developed, some future landuse change is inevitable. As those changes occur, storm water on construction sites may wash sediment and nutrients attached to that sediment into the streams. Construction site erosion anywhere in the watershed is a stakeholder concern and needs to be monitored since the majority of the watershed's soils are either Highly Erodible or Potentially Highly Erodible. US EPA mandates that anyone disturbing an acre of more of land must use Best Management Practices to keep soil in place during construction. Glenn Lange, Natural Resource Conservationist with the Marion County Soil and Water Conservation District (SWCD), told the Friends of Pleasant Run the following:

I attempt to inspect each site for the City of Indianapolis and as an agent for IDEM. We have MOUs [Memorandum of Understandings] *with both the City of Indianapolis and with IDEM* [Indiana Department of Environmental Management] *to assist with construction site compliance work. In general, about half of all of the construction sites in Marion County are out of compliance…when I conduct inspections (76.3% were out of compliance in 2008 and 50.3% were out of compliance in 2009). The 2008 figure represents only 65% of all sites that should have received inspections and the 2009 figure is most of the active sites that year. The slow down in the economy has slowed the construction activity in the county, allowing us to inspect a higher percentage of the sites. Although the compliance rate has improved, we think that 50% compliance is much too low. We have been urging the City of Indianapolis to improve their enforcement but have not*[had] *much success as yet.*

[7] http://www.indy.gov/eGov/City/DPR/Greenways/Pages/home.aspx

Plate 14: Construction Site in Pleasant Run Watershed

2.5.3 Fertilizer Use

Construction is not the only landuse activity that potentially can impact water quality. Stakeholders are concerned about what's being applied at golf courses, schools, homes, and commercial property in the watershed and the availability of zero phosphorus lawn fertilizer for residential use. Phosphorus is a nutrient needed by plants to thrive, but it can also create algal blooms and other water pollution problems. Very few soils in central Indiana require additional phosphorus, so using zero phosphorus fertilizer is an easy way the public can protect local water quality. The Friends of Pleasant Run found zero phosphorus fertilizer in the following stores through a random search of local big box and small hardware stores.

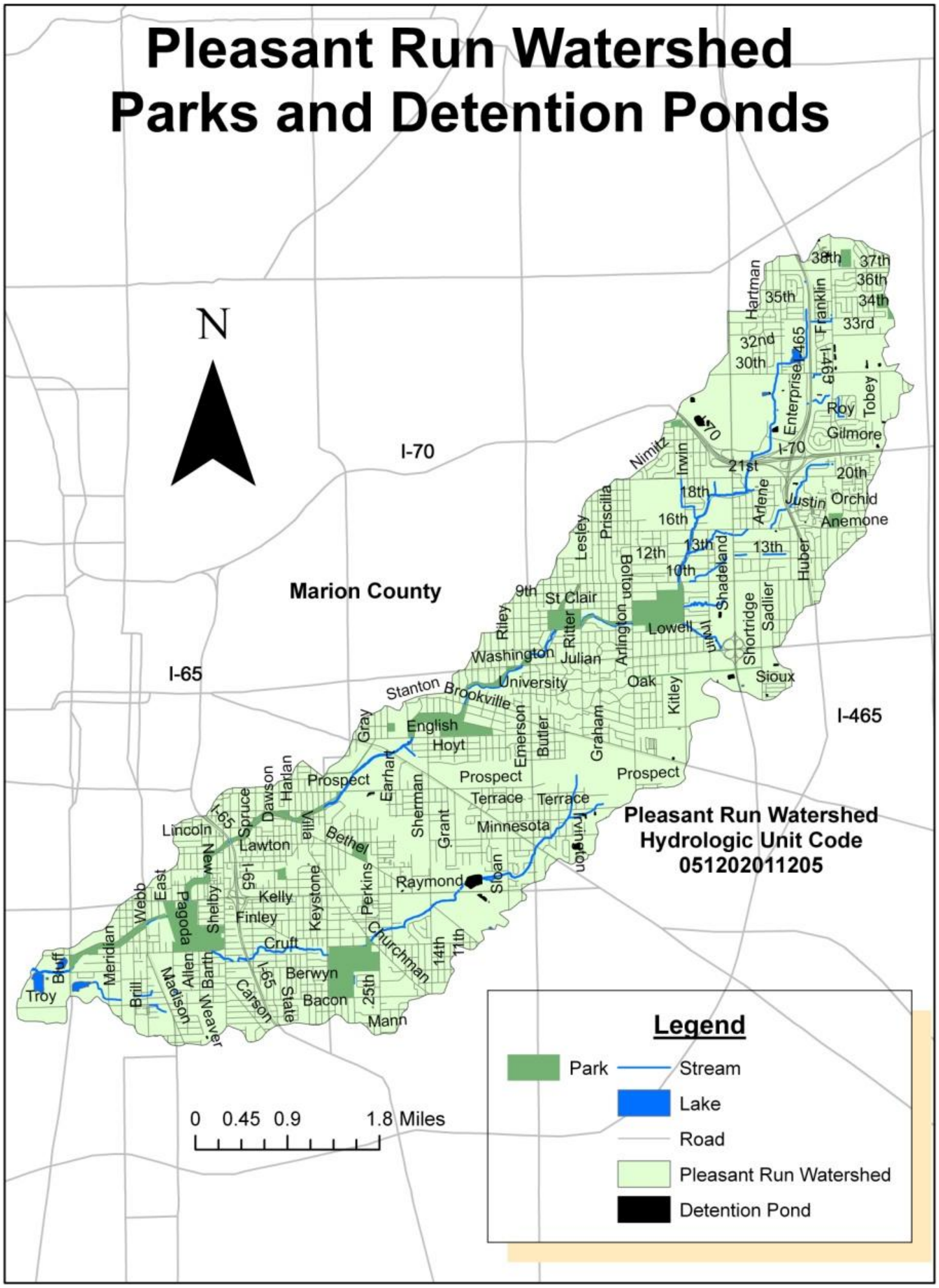
Figure 5: Zero Phosphorus Fertilizer Availability

Store	Zero Phosphorus Fertilizer Available	Comments
Ace Hardware: 1029 N. Arlington (317) 357-8396	Yes	Only available in early spring. Would have to speak to manager to order more. Makes the spring order in October.
Ace Hardware Twin Aire: 3000 Southeastern Avenue (317) 638-4591	Yes	Two types available in the store now.
Home Depot #2011: 2225 N. Post Road (317) 890-9771	Yes	They carry at least 2 brands with no phosphorus.
Kmart: 7425 E. Washington Street (317) 357-8556	Yes	Scott's Turf Builder.
Kmart: 2715 Madison Avenue (317) 783-6621	Yes	Scott's Turf Builder
Lowes #0272: 8801 E. 25th Street (317) 805-8400	Yes	They have 3 or 4 brands with no phosphorus.

There are two golf courses in the watershed: Pleasant Run Golf Course, which buffers Pleasant Run, and Sarah Shank Golf Course, which buffers a tributary of Bean Creek. An Indy Parks and Indiana Department of Transportation project designed to improve stream bank stability by re-grading parts of the bank within Pleasant Run Golf Course and removing invasive species is scheduled for winter 2011/2012. Friends of Pleasant Run were not able to learn how the golf courses' turf was managed. However, a water quality sampling site just downstream of Pleasant Run Golf Course did not show excess levels of phosphorus (see 3.5.1).

2.5.4 Pet and Wildlife Waste

Map 10 Pleasant Run Watershed Parks and Detention Ponds



Another landuse commonly associated with runoff pollution are areas where pet or wildlife waste can wash into the streams. As discussed above, Pleasant Run Watershed has several parks and a connecting Greenway system. The parks attract not only wildlife but also dog owners exercising their pets. Sadly, too many owners fail to pick up after their dog, and that waste can contribute bacteria and nutrients to the streams. This occurs at private residences not only parks. Storm water ponds may be an even bigger source of bacteria and nutrients. Designed to hold and slowly release storm water collected from adjacent impervious surfaces, storm water ponds attract many different types of wildlife; with perhaps geese being most common. Map 10 shows parks and storm water detention ponds in the Pleasant Run Watershed.

2.5.5 Invasive Species

Invasive plants are often native to Indiana and consequently provide lower quality food and habitat for native wildlife and birds. They become established in an area easily and spread quickly, crowding out other more desirable species. Invasive species are common throughout the Pleasant Run Watershed. As the watershed was developed, many invasive species were introduced. Some of these were brought to the area by mistake, some because they were thought more attractive than native species, and some because of a benefit they offer, such as erosion control. Invasive plants can negatively affect natural areas by altering nutrient cycling, using water more quickly than native plants, forming dense thickets that block out light, and giving off chemicals in the soil that inhibit growth of native plants. Invasive insects such as the Emerald Ash Borer can kill mature trees and dramatically change the face of the urban forest.

Invasive species in the watershed are common along the riparian corridor of Pleasant Run, especially Asian bush honeysuckle and tree of heaven. Asian bush honeysuckle and other invasive plant species shade out the native herbaceous layer that keeps soil in place along the streams. The bare ground underneath mature honeysuckle promotes erosion that adds sediment and nutrients to the streams. As part of their 2008 Day of Service, Lilly Company removed invasives along Pleasant Run from Bluff Road almost up to Washington Street. Volunteers did not work in Garfield Park because Indy Parks already had contractors removing invasives within the park. Several members of the public were concerned about how quickly the invasives returned in Garfield Park. Controlling invasives over the long-term is difficult and something that Indy Parks, Keep Indianapolis Beautiful, and other organizations are doing with varying levels of success. Reasons why invasives may have returned quickly at Garfield Park, compared to the areas Lilly volunteers worked, are unclear. Invasive species found in Marion County, and most likely present in the Pleasant Run watershed include the following (source: Indiana Cooperative Agricultural Pest Survey Program - http://extension.entm.purdue.edu/CAPS/):[8]

Figure 6: Common Invasive Species

Invasive Insects		
Banded Elm Bark Beetle	Common Pine Shoot Beetle	Granulate Ambrosia Beetle
Chinese Longhorned Beetle	Emerald Ash Borer	Soybean Aphid
Invasive Plants		
Asian Bush Honeysuckle(s)	Common Reed (Phragmites)	Japanese Hops
Autumn Olive	Creeping Jenny	Japanese Knotweed

[8] Invasive research and text by Angela Sturdevant

Invasive Plants		
Black Alder	Crown Vetch	Japanese Stilt Grass
Black Locust	Curly-Leaf Pondweed	Leafy Spurge
Black Swallow-Wort	Dame's Rocket	Multiflora Rose
Buckthorn(s)	Garlic Mustard	Norway Maple
Canada Thistle	Japanese Honeysuckle	Oriental Bittersweet
Periwinkle	Reed Canary Grass	Sweet Clover(s)
Privet(s)	Siberian Elm	Tall Fescue
Purple Loosestrife	Smooth Brome	Tree of Heaven
Purple Winter Creeper	Star-of-Bethlehem	White Mulberry
Winged Burning Bush	Black Jet Bead	Japanese Barberry
Lesser Celandine	High Bush Cranberry	

2.5.6 Combined Sewer Overflows

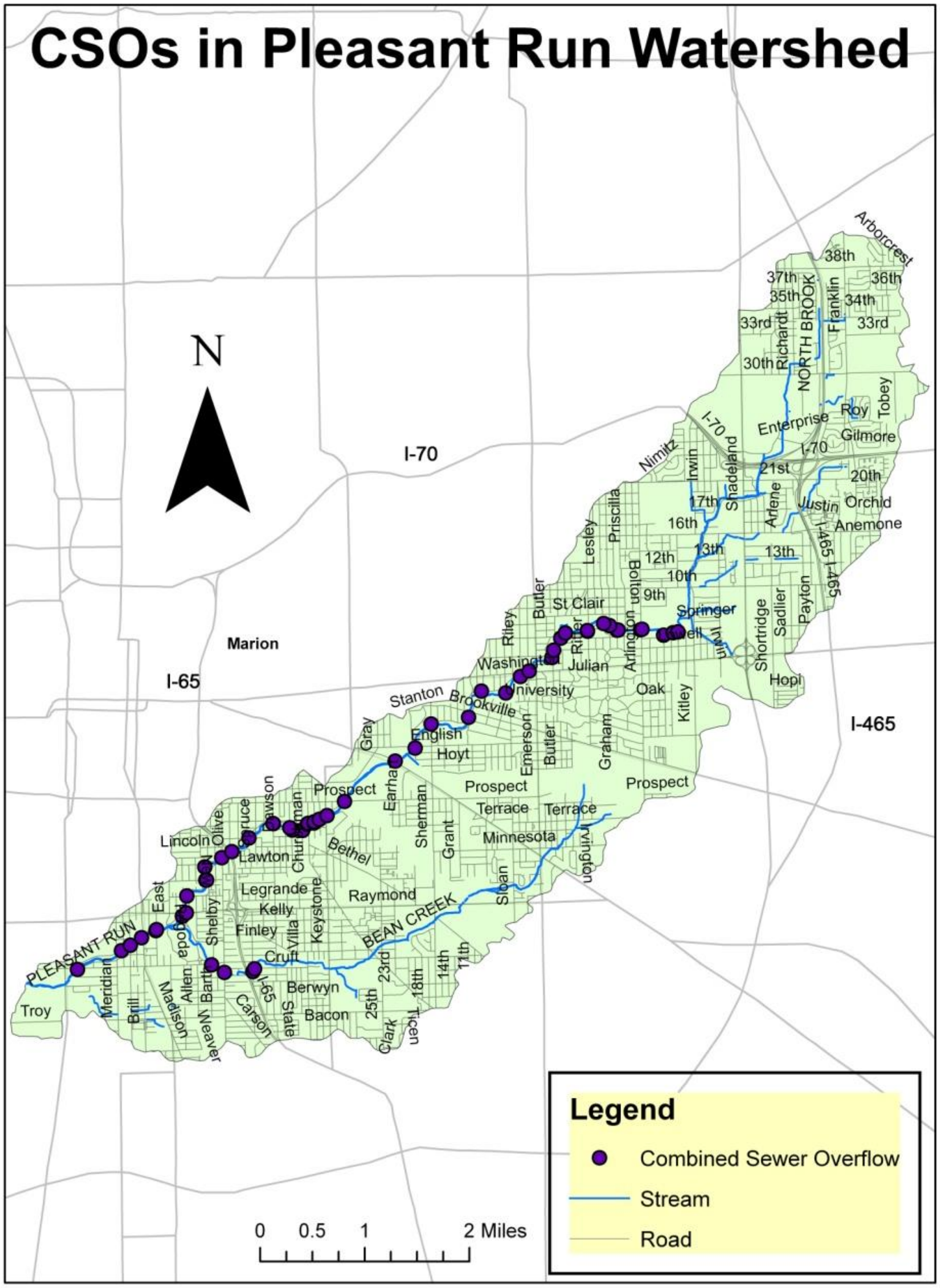
Combined Sewer Overflows (CSOs) are direct outlets to streams that, when it rains, sometimes release untreated sewage. These releases occur because CSO systems use one pipe to transport sewage and storm water. Often when it rains even 0.25 inches, the pipe can't hold both the sewage and storm water, so both overflow untreated into local streams. CSOs were originally designed as a failsafe in the event of major storms, but they are old technology now and due to the increase of impervious surfaces, rain events all too often overwhelm their capacity. Pleasant Run Watershed has 55 CSOs and they are a major source of bacteria, nutrient, and storm water pollution into the city's streams. Map 11 shows the location of CSOs in the Pleasant Run Watershed: notice that both Pleasant Run and Bean Creek have upstream areas without any CSOs. In these areas storm water does not flow into a CSO. This point becomes important when looking at the water quality data.

Plate 15: CSO in Ellenberger Park

Plate 16: Diagram of a Combined Sewer Overflow[9]

[9] http://www.wilmingtoncso.com/pages/projects/CSOfaq.htm

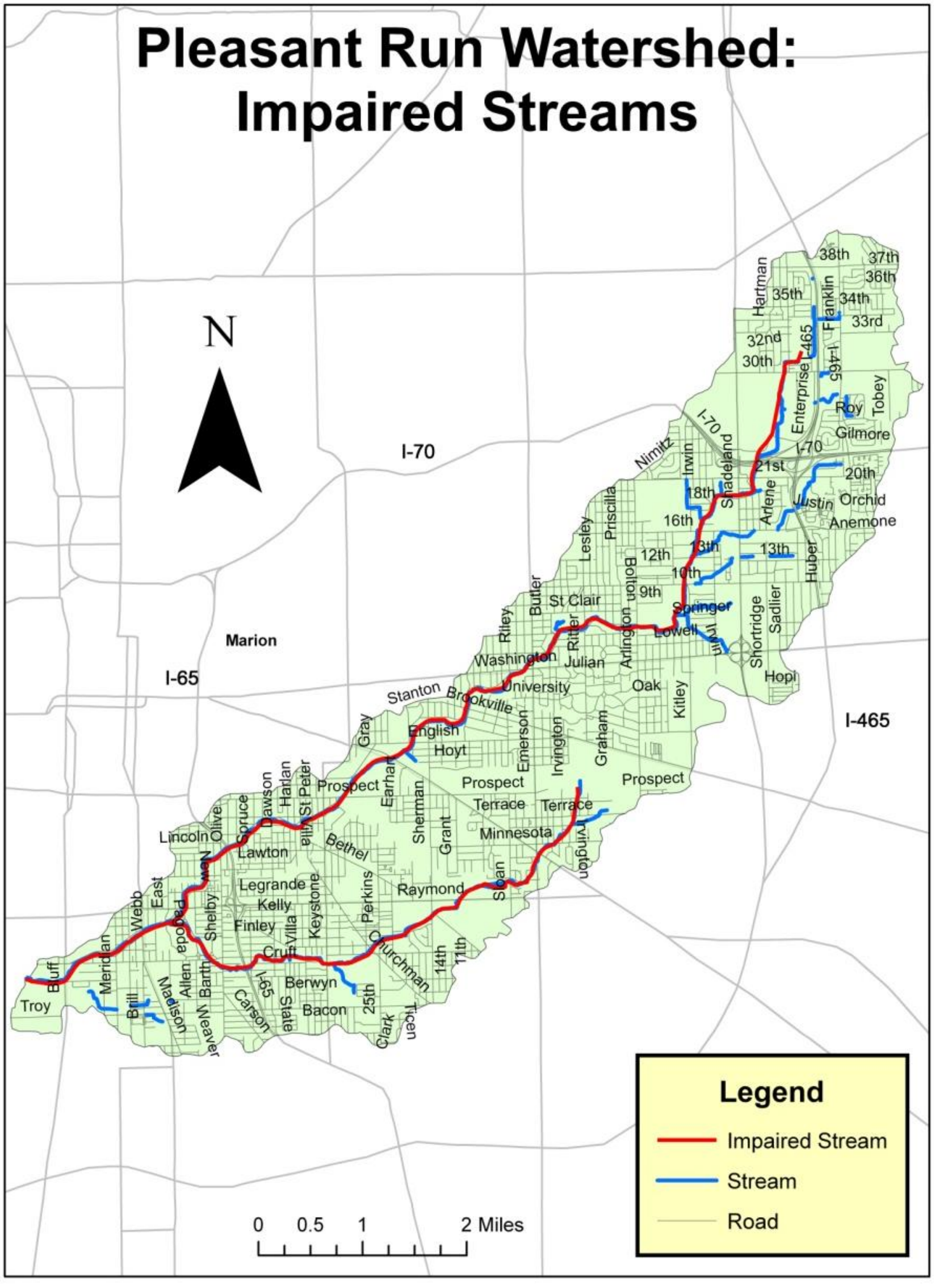
Map 11: CSOs in Pleasant Run Watershed



2.6 Other planning efforts in the watershed

Many city, state, and private organizations' mission and interests overlap with the Pleasant Run Watershed. Below is a brief synopsis of each of those organizations and how their long-term goals may impact Pleasant Run and Bean Creek.

Map 12: Impaired Streams in Pleasant Run Watershed



The Clean Water Act mandates the Indiana Department of Environmental Management (IDEM) to assess the State's surface water quality and list those bodies of water that don't meet state water quality standards. IDEM has determined that Pleasant Run and Bean Creek are both impaired (which means not meeting state water quality standards) for E. coli bacteria and biotic communities (Map 12). Biotic communities is a measurement of the biological life in a stream. IDEM has written a Total

Maximum Daily Load (TMDL) for E. coli. The TMDL provides some broad information about Pleasant Run Watershed, pollution sources contributing E. coli to Pleasant Run and Bean Creek and then calculates the total amount of E. coli the stream can accept and still meet state water quality standards. Important conclusions from the *IDEM Pleasant Run and Bean Creek TMDL Study September 2003* are below.

- Sources of E. coli bacteria in the watershed include Combined Sewer Overflows (CSO), urban storm water, failing septic systems, illicit storm drain connections, and pollutants from wildlife and domestic animals.

- More than 90% of the sampling stations exceed the daily maximum E. coli bacteria standard (235 cfu/100 ml) more than 50% of the time.

- All of the sampling stations with sufficient data (5 samples in 30 days) exceed the geometric mean E. coli bacteria standard (125 cfu/100 ml) 100% of the time.

- A 92% reduction in E. coli bacteria is needed to meet water quality standards upstream of the CSO area.

- A 99.9% reduction in E. coli bacteria is needed to meet water quality standards within the CSO area.

Indianapolis-Marion County Comprehensive Plan[10]

The Plan was developed between 2000 and 2006. It has two parts and the product, as well as the process that developed it, is called Indianapolis Insight. It replaces a plan developed in 1991-93. The Plan has two sections, a Community Values narrative and a set of maps.

The Plan is available at: http://www.indy.gov/eGov/City/DMD/Planning/Insight/Pages/home.aspx

The Community Values narrative is at: http://www.indy.gov/eGov/City/DMD/Planning/Insight/CommVal/Pages/home.aspx

The Plan has specific sections on Water Resources, Watersheds, Storm water and Flood Control, and Combined Sewer Outflows, but does not provide details on specific future projects. Rather, it presents policies and recommendations. Major goals or objectives that relate to the Pleasant Run Watershed and offer Friends of Pleasant Run a glimpse of the type of activities Indianapolis would support include:

- Encourage development practices that protect existing natural features/assets, promote innovative land use designs & focus on sustainable natural systems.

- Foster public life throughout the city by incorporating a variety of open spaces & community gardens into neighborhoods. These areas can function as “public living rooms” for informal gathering & recreation.

- Develop standards for the ongoing maintenance of storm water devices (retention ponds, inlets & outfall structures, buffer areas, etc.)

- Activate Marion County watershed coordination with governments in the region.

- Use parkways, Indy Parks Greenways, open space areas & other community assets as economic development tools to attract new businesses & residents.

[10] Information about the Comprehensive Plan gathered by Michael J. Finnerty 10.15.10

- Amend the Zoning Ordinances to require preservation of existing dense vegetative cover or the planting of dense vegetative cover along stream & tributary banks for the purposes of erosion control, contaminant capture, water cooling (important for retaining oxygen levels) and habitat preservation.

- Develop a county-wide tree conservation ordinance for both public and private land that limits site clearing, & uses a tiered approach based on forest types.

- Provide mitigation options such as tree banking or open space banking.

Indianapolis Municipal Separate Storm Sewer System (MS4) Program

An MS4 is a conveyance or system of conveyances (sewers, roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains) designed to move storm water off the land. The extra water flow associated with storm water, as well as the sediment in that water, contributes to the degradation of streams and rivers. US EPA has mandated that certain urban areas (including Indianapolis) manage their MS4s to reduce this degradation. The MS4 program has six requirements.

1. Public education and outreach;

2. Public participation/involvement;

3. Illicit discharge, detection and elimination;

4. Construction site runoff control;

5. Post-construction site runoff control; and

6. Pollution prevention/good housekeeping.

Indianapolis Parks Master Plan[11]

The Indianapolis Parks Department Master Plan was completed in 2009 and is scheduled to be updated every five years. Like the city master plan, the park plan's goals offer Friends of Pleasant Run an idea of the type of projects Indy Parks may want to partner on. Specific examples of projects could be identified by working with Indy Parks planning staff. In meetings with Friends of Pleasant Run, Indy Parks has shared that installing water quality projects on parks property will be difficult unless the project has an endowment for continued maintenance.

- Identify areas in parks to increase tree canopy.

- Identify areas for rain gardens and rain barrels in our parks.

- Act as a leader in the area of brownfield re-use, focused on park and open space development.

- Work to provide additional public access to our waterways.

- Continue to improve natural areas on City golf courses as wildlife habitat and explore

  their value for Environmental Education.

[11] http://www.indy.gov/eGov/City/DPR/Admin/Planning/Pages/home.aspx

Indianapolis Green Infrastructure Master Plan for Water Quality Improvement

The Green Infrastructure Master Plan for Water Quality Improvement was prepared for the City of Indianapolis Office of Sustainability, Department of Public Works. A draft was made available to Friends of Pleasant Run in the spring of 2011. Green Infrastructure are practices like bioretention, rain gardens, swales, green roofs, and impervious pavement that infiltrate storm water into the ground rather than collecting it in a detention pond that eventually releases it into a stream. Goals and objectives of this master plan include:

- Help the City make decisions on the types, locations, benefits, and costs of green infrastructure (GI) needed to help meet the city's sustainability goals

- Identify and evaluate GI best management practices (BMPs) to help the City improve water quality in storm water runoff, decrease the peak rate of runoff to the runoff collection system, and help restore or better mimic pre-development hydrology

- Provide site-specific, cost effective GI projects to reduce CSO volume and provide for attainment of State and Federal water quality standards

- Promote cost effective implementation by coordinating Low Impact Development and GI initiatives with existing Capital Improvement Projects (CIP) proposed within the City. (IDEM defines LID as an approach to land development (or re-development) that works with nature to manage storm water as close to its source as possible. LID employs site design principles such as preserving and recreating natural landscape features and minimizing land disturbance.)

- Help identify and incorporate specific GI solutions into currently planned Capital Improvement Projects

Results of the study indicate GI can:

- Reduce the peak annual rate of flows to the sewer system by more than 50% in selected areas

- Reduce the peak rate of the 3-month return interval storm (12-hour, 1.39 in) by 100% in selected areas

- Prevent up to 5 billion gallons of annual flow in the combined sewer area from entering inlets to the existing collection system

- Save up to 5 million dollars annually in the cost of treatment of flow otherwise directed to the wastewater treatment plant

- Provide incremental improvement over time as GI is implemented

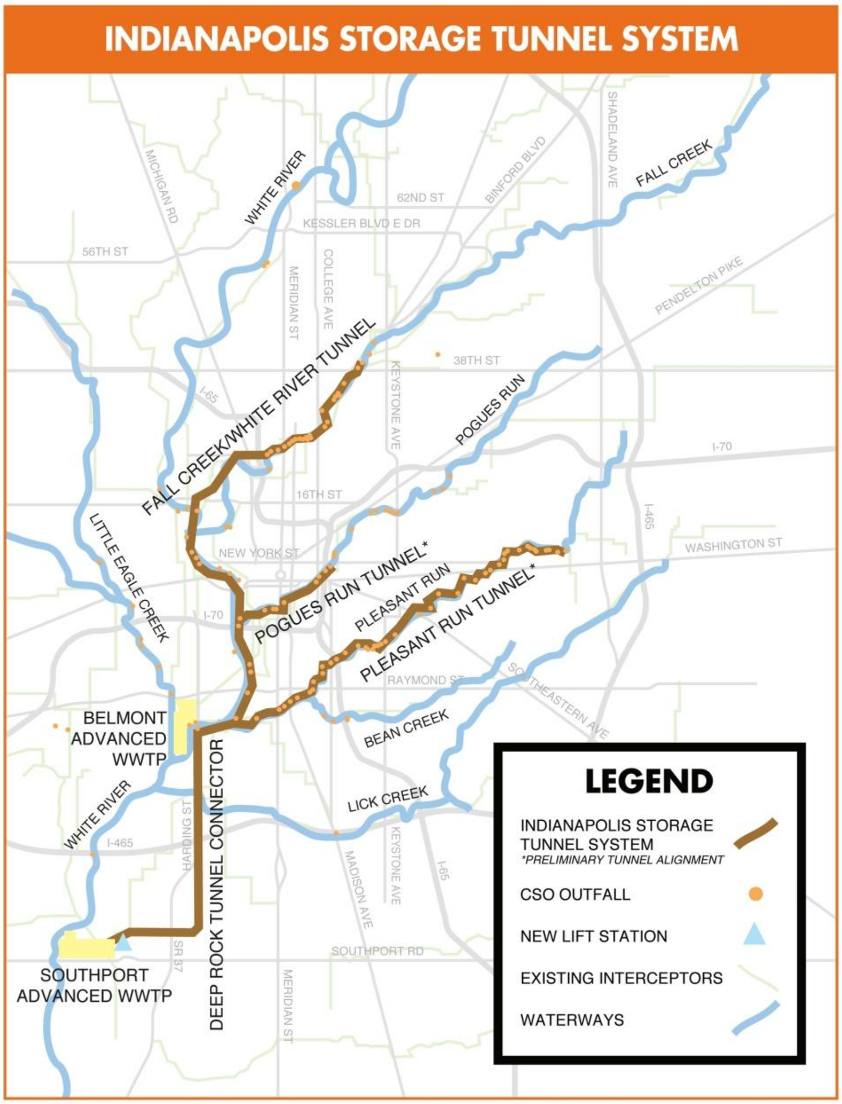
The Green Infrastructure Plan suggests projects from several parts of the Pleasant Run Watershed, and those will be discussed in Part Two of the Watershed Inventory.

Combined Sewer Overflow Long Term Control Plan

As described in Section 2.5, Pleasant Run Watershed has 55 CSOs along its waterways. When it rains, untreated sewage overflows into the streams, making them unsafe for human contact and harming the streams biologic life. Under a United States Environmental Protection Agency mandate, Indianapolis has committed to eliminating 95% of the overflows in the Pleasant Run Watershed. The 'Long Term Control Plan' involves a series of underground tunnels across the city where untreated storm water and sewage can be stored and then pumped to wastewater treatment plants when plant capacity is available. Construction on

Indianapolis' first tunnel is scheduled to begin in 2011, with the whole project not scheduled to end until 2025. The Pleasant Run tunnel is still in the planning stages and construction likely won't begin until 2019. Once the project is complete, overflows in the Pleasant Run Watershed will be limited to no more than four per year.

Plate 17: Indianapolis Storage Tunnel System[12]



Indianapolis Septic Tank Elimination Program (STEP)

As described above, septic systems need specific soil types to function properly. Over 60% of the soils in the Pleasant Run Watershed are unrated for septic suitability. 27% of the soils are rated very limited for septic suitability. Discharge of effluent from failing septic systems can introduce pathogens, parasites, bacteria, and viruses, which can cause disease through body contact or ingestion of contaminated water. E. coli and other pathogens pose a particular threat when sewage pools on soil or migrates to recreational waters.

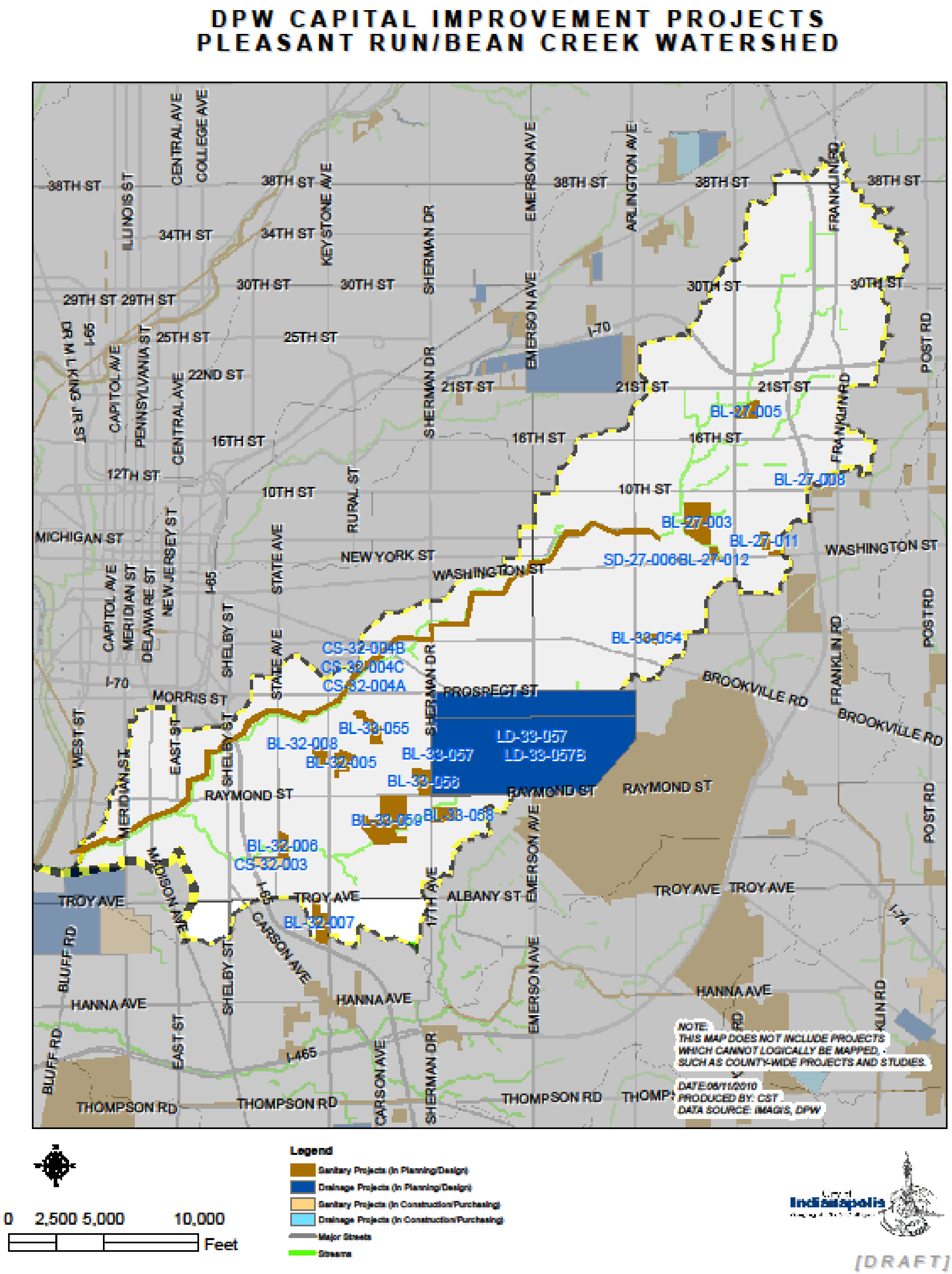
Indianapolis eliminates septic systems and connects homes to sanitary sewers through the Septic Tank Elimination Program (STEP). Under STEP, property owners pay a one-time connection fee and are responsible for private property construction costs associated with connecting their homes to the sanitary sewer. The city is responsible for all construction costs within the public right-of-way. Figure 7 below shows future Indianapolis Department of Public Works projects in the Pleasant Run Watershed. Using Figure 7 and Map 13, the location of STEP projects and other city projects to improve water quality can be located.

[12] http://www.indy.gov/eGov/City/DPW/Environment/CleanStream/Projects/Documents/Indy_Storage_Tunnel-System.JPG

Figure 7: Pleasant Run/Bean Creek Watershed Sanitary and Storm Water Projects

TYPE	PROJECT NUMBER	PROJECT NAME	PRIMARY STATUS	BID DATE	TOTAL COST
PROJECTS PLANNED FOR 2010-2014					
Sanitary	CS-32-003	CSO 017 Elimination	(3) In Purchasing	5/6/2010	$ 565,000
Storm	SD-32-003A	South Keystone Drainage Improvements	(1) In Planning	12/13/2013	$ 335,000
Storm	SD-33-057B	Bean Creek Neighborhood Area Stormwater Improvements	(1) In Planning	10/29/2014	$ 2,950,000
STEP	BL-27-003	10th/Pleasant Run STEP	(1) In Planning	12/31/2014	$ 2,645,325
FUTURE PROJECTS					
Storm	SD-27-006	Kenyon & Washington Streets Drainage	(1) In Planning	Future	$ 154,500
Storm	LD-33-057	Bean Creek Stormwater Detention Area	(1) In Planning	Future	$ 3,500,000
Sanitary	CS-32-004C	Pleasant Run Deep Tunnel (PRDT) Construction, Phase 3 (PER 9)	(2) In Design	Future	$ 217,500,000
STEP	BL-27-005	Pleasant Run PKWY/Shadeland Avenue	(1) In Planning	Future	$ 1,708,200
STEP	BL-27-012	Edmondson Avenue/Washington Street	(1) In Planning	Future	$ 597,870
STEP	BL-32-005	Bethel Avenue/Luther Street	(1) In Planning	Future	$ 1,708,200
STEP	BL-32-006	Walker Avenue/Nelson Avenue	(1) In Planning	Future	$ 1,708,200
STEP	BL-32-007	Troy Avenue/Harlan Street	(1) In Planning	Future	$ 2,419,950
STEP	BL-32-008	Iowa Street/Churchman Avenue	(1) In Planning	Future	$ 1,480,440
STEP	BL-33-055	Terrace Avenue/Minacqua Avenue	(1) In Planning	Future	$ 2,847,000
STEP	BL-33-059	Churchman Road/Perkins Avenue	(1) In Planning	Future	$ 5,124,600
STEP	BL-27-008	13th Street/Huber Street	(1) In Planning	Future	$ 1,281,150
STEP	BL-33-054	English Avenue/Arlington Avenue	(1) In Planning	Future	$ 341,640
STEP	BL-33-056	Sherman Drive/Galhoun Drive	(1) In Planning	Future	$ 711,750
STEP	BL-33-057	Van Buren/Sherman Drive	(1) In Planning	Future	$ 654,810
STEP	BL-27-011	Shortridge Road/Washington Street	(1) In Planning	Future	$ 455,520
STEP	BL-33-058	Sherman Drive/Bethlehem Avenue	(1) In Planning	Future	$ 284,700

Map 13: DPW Capital Improvement Projects: Pleasant Run/Bean Creek Watershed



Southeast Neighborhood Development Organization (SEND)[13]

Southeast Neighborhood Development, Inc. (SEND) is a non-profit community development corporation created by neighbors in 1991 to revitalize the near southeast side of Indianapolis. SEND has a Pleasant Run subcommittee that promotes the organization's mission and goals relating to the stream and its use. SEND priorities for Pleasant Run are:

- Plan and implement initial stream bank restoration pilot project.

- Advocate for a defined connection between Pleasant Run, White River, and the Cultural Trail and the University of Indianapolis (via Shelby Street).

- Promote the recreational use of the Indy Parks Greenways connections at Garfield Park and future connections at White River and the Cultural Trail.

- Advocate with appropriate city agencies for the maintenance, beauty, navigability, and safety of the Pleasant Run Parkway trail.

- Advocate for the realignment of the Pleasant Run Parkway trail between Prospect and English through the former Citizens Gas plant.

Keep Indianapolis Beautiful[14]

Keep Indianapolis Beautiful (KIB) is a community nonprofit with a mission to unite people to build community and transform public spaces through aesthetic and environmental improvement. KIB offers several programs in four core areas: Trees, Education and Youth Initiatives, Greenspace and Gateways, and Litter Cleanups and Recycling. KIB depends on the public to drive their long term vision. Project ideas are accepted from neighborhood groups and implemented as staff and resources become available. KIB has participated in three recent projects in the Pleasant Run Watershed:

- Spring 2008 Lilly Day of Service event that removed honeysuckle from Bluff Road to Washington Street.

- Planted 500 trees on Pleasant Run Parkway between Raymond and Keystone during spring of 2009.

- Planted a rain garden in the Harlan Triangle in the spring of 2010.

KIB has expressed interest to Friends of Pleasant Run about additional projects in the watershed.

Irvington Green Initiative[15]

The Irvington Green Initiative (IGI) is a subcommittee of the Irvington Development Organization, a membership-based non-profit aimed at preserving the Irvington neighborhood's stability and charm while also encouraging measured economic growth. The IGI has a mission of a sustainable urban environment. They work towards this goal by holding environmental educational events and promoting practices aimed at sustainable lifestyles.

[13] http://www.sendcdc.org/
[14] http://www.kibi.org/
[15] http://www.irvingtondevelopment.org/

2.7 Threatened and Endangered plants and animals

Lack of wildlife was mentioned as a stakeholder concern. The Indiana Department of Natural Resources maintains a County Endangered, Threatened and Rare Species List. The list for Marion County is in Appendix D. While these listed species historically thrived in Marion County and presumably the Pleasant Run Watershed, urbanization and its many consequences may preclude all species from fully recovering. Many types of mussels, for instance, are pollution intolerant, and Marion County streams, with their myriad of point and nonpoint sources, temperature fluctuations, and storm water influences, may never be able to fully support a wide variety of mussel species again. Large mammals such as the Bobcat, Northern River Otter, and American Badger which need adequate habitat space may not ever fully return either. Encouraging wildlife signs do exist, as the Project Coordinator saw fox, blue herons, and beaver while doing field work for this project.

2.8 Relationships between watershed characteristics discussed in Part 1 of the Watershed Inventory

Many items discussed in Part 1 of the Watershed Inventory relate to one another and offer Friends of Pleasant Run clues about where problems are and ideas on possible partnerships and projects that may improve the watershed.

- The prevalence of hydric soil in the headwaters relates to many topics. First, that area is very limited in terms of septic system suitability, yet information from STEP shows that septics exist there. Many of these systems are likely contributing bacteria and nutrients to the watershed's streams. Second, although hydric soils support wetlands nearly all of them have been drained. The lack of wetlands and prevalence of ditches represent extensive hydrologic modification of the headwaters. Threatened and endangered species would benefit if some of the wetlands could be restored. Overall water quality, and possibly biotic community scores, could improve by increasing the infiltration and filtering ability of the ditches.

- Indy Parks' current budget and existing agreements may inhibit certain practices from being installed on their property, but the Parks, Indy Parks Greenways, and Golf Courses offer so many opportunities that they deserve mention. First, these landuses have wildlife habitat, and if that habitat is improved it may help some of the watershed's threatened and endangered species. The City Master Plan and Indy Park's Plan lists increasing the number of trees as a goal; perhaps Friends of Pleasant Run can partner with those stakeholders, as well as KIB and SEND to plant trees in the watershed. Trees not only catch storm water, but their root systems help infiltrate it into the ground. The Park's Plan also mentions a desire to add rain gardens and rain barrels on Park property. A final opportunity is to work with Indy Parks on invasive species removal.

- Data from the city shows that the public regularly comes in contact with the watershed's streams; despite posted warnings that the water is polluted. Once the CSO problem is addressed and STEP eliminates septics, public health risks associated with stream contact may be relaxed. Parks and detention ponds are still a source of bacteria though. Plantings in and around detention ponds can deter wildlife from the ponds and provide a water quality benefit to the pond and the stream it empties to.

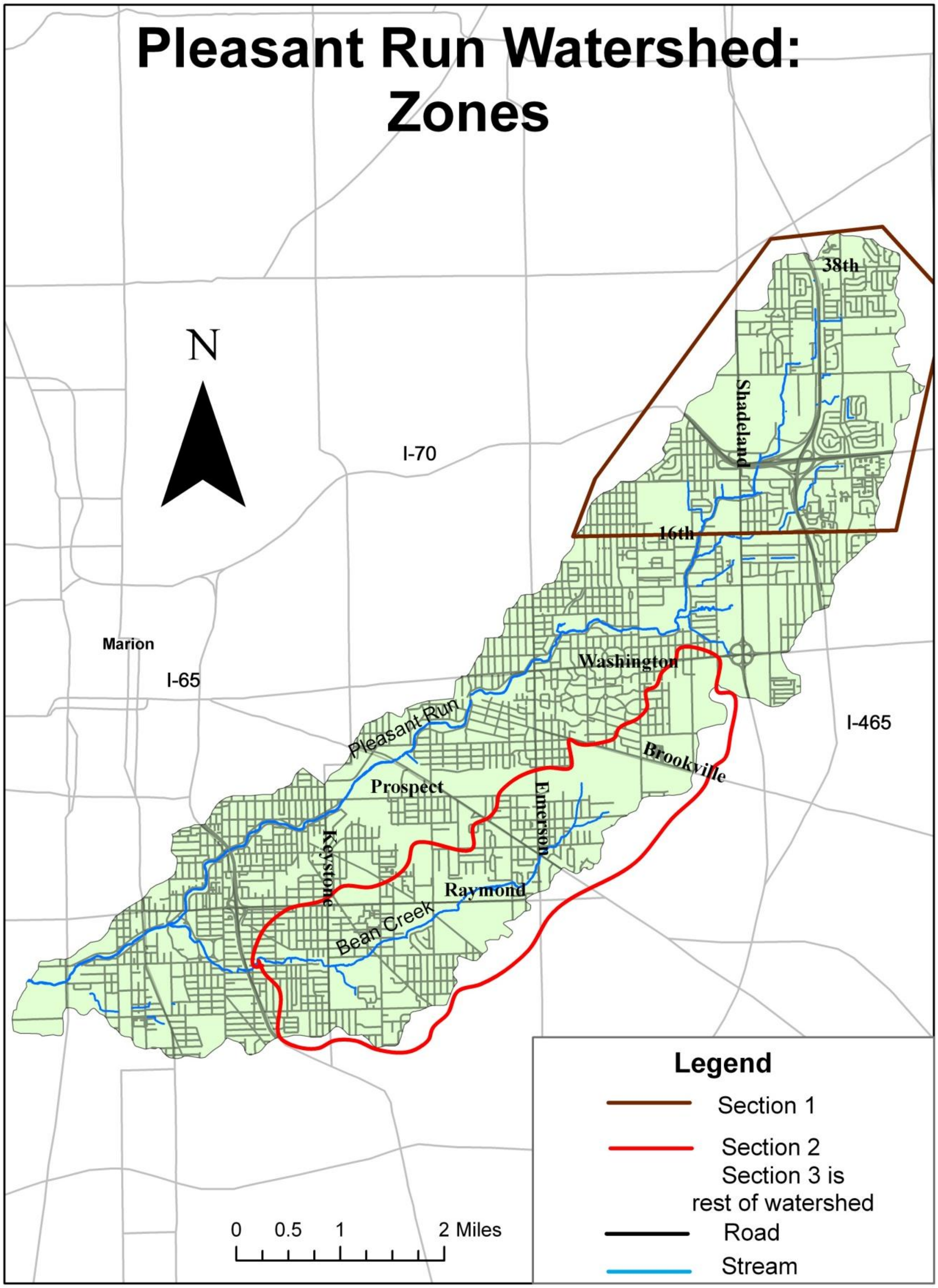
- As shown on Map 13, Indianapolis Department of Public Works has several Capital Improvement Projects (CIPs) planned for the watershed, including a large storm water project along Bean Creek. Partnerships with DPW to increase the water quality benefit of some of these projects might be possible. In addition, the city's Green Infrastructure Plan cites CIPs as a good opportunity to implement some of the GI practices outlined within that document.

- Pleasant Run Watershed can be described as 'built out'. Large undeveloped tracts of land simply don't exist anymore. The urbanization has greatly increased the amount of storm water flowing off the land. While reducing storm water across all landuses is important, the biggest landuse in Pleasant Run Watershed is residential neighborhoods and stream quality won't improve without focused efforts to educate homeowners and promote residential storm water practices in critical areas.

Watershed Inventory Part 2

3. 1 Introduction to Watershed Inventory Part 2

Map 14: Pleasant Run Watershed: Zones



The Indiana Department of Environmental Management recommends dividing the watershed into zones as a way to provide a more detailed narrative of the data and its implications. Friends of Pleasant Run divided the watershed into three zones (Map 14). The second part of the Watershed Inventory has information on water quality, biological, and landuse data specific to the three zones. Zone 1 is Pleasant Run above Indianapolis Department of Public Works sampling site 3 (see Section 3.2 for more information about sampling sites). Zone 2 is Bean Creek above Indianapolis Department of Public Works sampling site 4. Zone 3 is the rest of the watershed. These zones were chosen because there are no CSOs above DPW sample site 3 and 4; so comparisons can be made between the CSO and non CSO parts of the watershed. They were also chosen because the sample sites are roughly situated to provide data on the headwaters of each stream. A tried and true definition of 'headwaters' doesn't exist, although for small streams like Pleasant Run and Bean Creek, the watershed's first square mile is often used. Another common definition of headwaters is the small drainage networks, wetlands, and seeps that make up a stream's source. The importance of protecting a watershed's headwater region, especially in an urban environment can't be understated. A healthy headwaters maintains water quality and quantity, recycles nutrients, creates habitat for plants and animals, and mitigates flooding. These benefits in turn flow downstream and positively impact the rest of the watershed.[16] Both KIB and Indy Parks encouraged Friends of Pleasant Run to focus on headwater restoration.

3.2: Data and Targets

Data for Part Two of the Watershed Inventory was collected in a variety of ways. Friends of Pleasant Run spent time calling, emailing, and visiting with city, state, and federal agencies as well as private organizations and businesses, neighborhood groups, and individual citizens. As needed, volunteers did windshield surveys to locate buffers and areas of bank erosion. This work was primarily done between November 2010 and May 2011 to spot check information that was gathered from city maps and information provided by city officials.

Members of the steering committee made a big contribution by creating a stream buffer map of the entire watershed. Each steering committee member took a small piece of the watershed, and using online aerial photos, marked the location of tree, shrub, grass, and impervious buffers and areas of stream bank erosion. A buffer was defined as the first 20 feet of each stream bank.

Plate 18: Grass Buffer Provides Minimal Water Quality Benefit

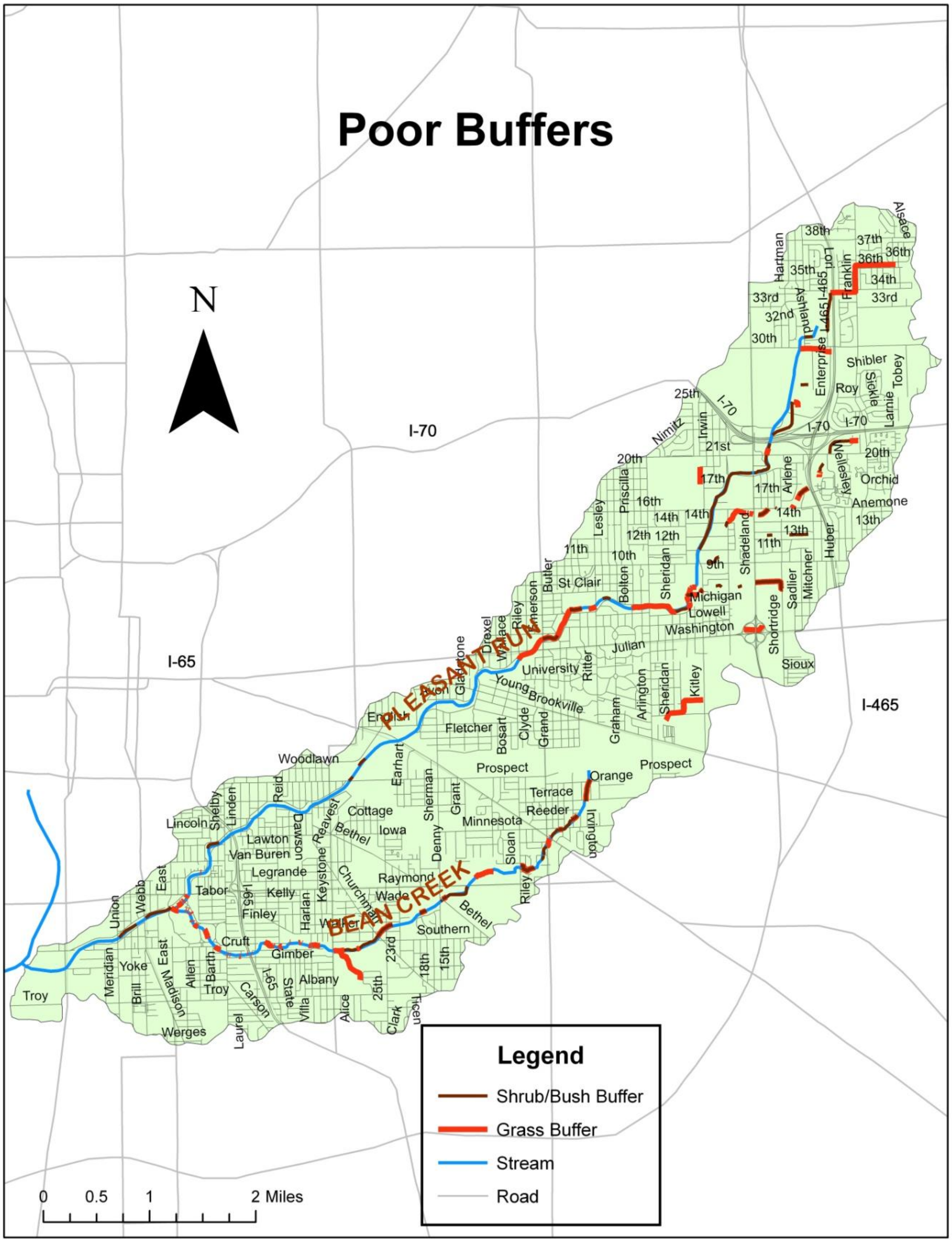
Plate 19: Tree Buffer Provides Maximum Water Quality Benefit

The volunteers gathered buffer information during autumn and early winter 2010. Mundell and Associates then digitized the

[16] http://www.americanrivers.org/our-work/clean-water/streams-wetlands/scientific-importance.html

information and mapped it (Appendix E). Stream buffers can help protect water quality by providing shade that regulates water temperature, filtering runoff that passes through it on the way to the stream, stabilizing the stream banks, and providing dead limbs and other plant matter than aquatic organisms use as habitat. Areas marked as grass or shrub/bush were assumed to be 'poor' buffers that could be improved with additional plantings (Map 15). Those using the maps to identify potential project areas should remember they are a compilation of work done by several volunteers and field work may be necessary.

Map 15: Poor Buffers



Water quality data comes from three agencies: IDEM, DPW, and Marion County Health Department (MCHD). IDEM only collected samples over a few months for the TMDL (see Section 2.6), but DPW and MCHD have collected data at the same sites for over ten years and continue to sample. Keep in mind also that these data were all collected for different reasons.

- IDEM sampled in order to write a TMDL for E. coli bacteria. Since E. coli is a human health risk, samples were only taken during the recreational season (April through October) when people are assumed to come in contact with the water. Only enough samples were taken to determine if the Indiana Water Quality Standard for E. coli was being met. The TMDL's bacteria conclusions were a large part of the water quality discussions below.

- MCHD collects benthic macroinvertebrates from streams throughout the county. Benthic macroinvertebrates are animals lacking backbones (invertebrate), which can be seen with the naked eye (macro), and live part of their lives on or in the bottom (benthos) of a body of water. There are many advantages of using benthic macroinvertebrates to assess the quality of a stream. The benthic macroinvertebrates are good indicators of localized conditions, as many of the animals have limited migration patterns.

Plate 20: Benthic Macroinvertebrates

Most species have a complex life cycle of one year or more. Sensitive life stages will respond quickly to stress; the overall community will respond more slowly. MCHD also does some chemical and bacteria sampling in order to find non-CSO influences of E. coli to Pleasant Run and Bean Creek.[17] The Project Coordinator reviewed the macroinvertebrate data. Enviro-Assist LLC graphed MCHD's E. coli and Dissolved Oxygen data for the last 5 years. Both were sampled multiple times a month and are the only parameters, sampled by any entity, with enough data points to show seasonal fluctuations.

- DPW collects chemical data as part of their storm water program. The parameters sampled represent a myriad of possible runoff pollutants and when compared to IDEM and MCHD data, answer more of the water quality questions Friends of Pleasant Run needs answered. Metals and other basic elements are also collected as part of the CSO program in order to help the city pinpoint possible illicit discharges and industries who may not be in compliance with their discharge permit (known as an NPDES permit). While certainly considering the influence of industry, Friends of Pleasant Run's goal is to study the runoff pollution. Responsibility for monitoring and enforcing industrial discharge permits falls with the city and state.

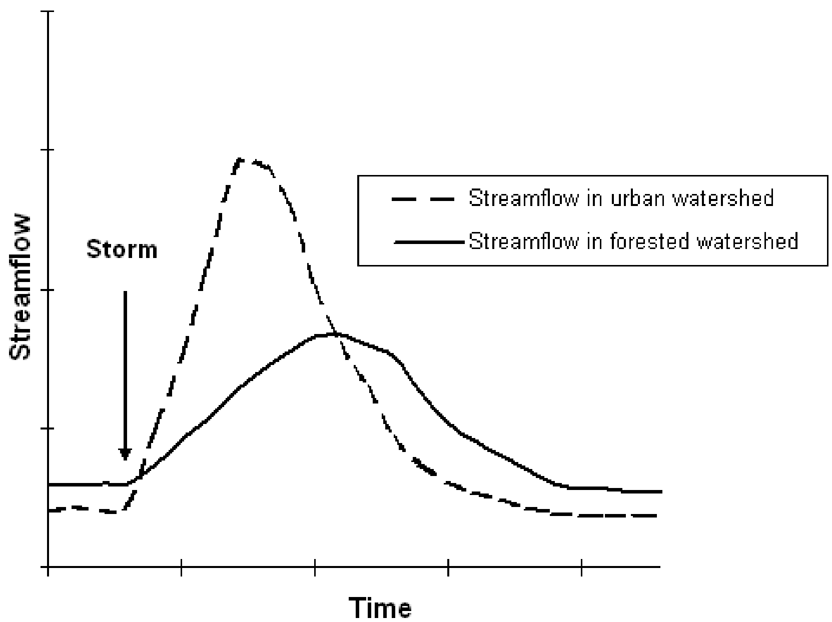
For every water quality parameter, Mundell and Associates calculated the mean and median values for wet and dry weather events. See the discussion below about wet and dry weather events. Means and medians were calculated because DPW's sampling frequency was not high enough to show seasonal fluctuations. The raw DPW data is in Appendix F.

The most serious drawback to these three data sets is that none of them include true 'wet' weather samples. Sampling during wet and dry weather, especially in an urban environment, can offer different types of information. Because runoff pollution is caused by storm water, it doesn't show up during dry weather sampling. Any pollution found during dry weather represents a source that continually flows regardless of weather: septic systems and factory discharges are common examples. Wet weather

[17] http://www.mchd.com/wq/html/macroinvertebrate.htm

sampling shows the influence of runoff on water quality, but only if taken at the right time. Because of the large amount of impervious surfaces, urban streams exhibit quick flow peaks during rain events. As Plate 21 shows, this means that during a storm the amount of water in an urban stream rises and falls quickly when compared to a nonurban stream. Sampling must be done during this peak of storm water to measure the true impact of runoff pollutants. None of the data sets represent such sampling, although the DPW data comes closest.

Plate 21: Urban vs. Forested Storm Flow[18]



When DPW sampled, they recorded the number of days since the last rainfall and the size of that rainfall (in inches). Using the definition of a wet weather event from Indianapolis' Long Term Control Plan, Friends of Pleasant Run defined a wet weather sampling event as one that occurred 72 hours or less after a rain event of at least 0.10 inch. All other DPW samples were defined as dry weather events. Since DPW didn't record the time of each rain event, it's nearly impossible to be 100% sure that each wet weather event was identified. It's also impossible to know how soon after it started raining that DPW took a sample. Friends of Pleasant Run assumes that the number of wet weather events are underestimated and our discussion of the watershed's water quality does not do justice to the influence of storm water.

Sampling points are shown below on Maps 16-18 and specific information about the sampled parameters commonly found in runoff is in Figure 8. DPW parameters associated with Point Sources are in Appendix G—Aluminum and Manganese did not have an identifiable target in the Indiana Administrative Code and are not included in Appendix G even though DPW sampled for them.

[18] www.ei.cornell.edu

Figure 8: Parameters Sampled in Pleasant Run Watershed

Parameter	Background	Typical Sources	Sampled By	Frequency	Standard/Target
Macroinvertebrates	Aquatic invertebrates live in the bottom parts of our waters. They make good indicators of watershed health because they live in the water for all or most of their lives, stay in areas suitable for their survival and differ in their tolerance to amount and types of pollution.[19]	Naturally occurring	MCHD	Yearly at 8 sites (ongoing since the 1990s)	Hilsenhoff's Biotic Index (HBI) Where: 0.00-3.75 Excellent 3.76-4.25 Very Good 4.25-5.00 Good 5.01-5.75 Fair 5.76-6.50 Fairly Poor 6.51-7.25 Poor 7.26-10.00 Very Poor
E. coli	*E. coli* is one member of a group of bacteria that comprise the fecal coliform bacteria and is used as an indicator organism to identify the potential for the presence of pathogenic organisms in a water sample. Pathogenic organisms can present a threat to human health by causing a variety of serious diseases, including infectious hepatitis, typhoid, gastroenteritis, and other gastrointestinal illnesses.[20]	CSOs, septic systems, wildlife/pet waste.	MCHD	5 times a month at 9 sites (ongoing since the 1990s)	Indiana Water Quality Standard: Shall not exceed 125 colony forming units (cfu) per 100 ml as a geometric mean based on not less than 5 samples equally spaced over a 30 day period nor exceed 235 cfu per 100 ml in any 1 sample in a 30 day period
			Department of Public Works	Monthly at 4 sites (ongoing since the 1990s)	
			IDEM	5 times a month at 23 sites from April to October 2002	

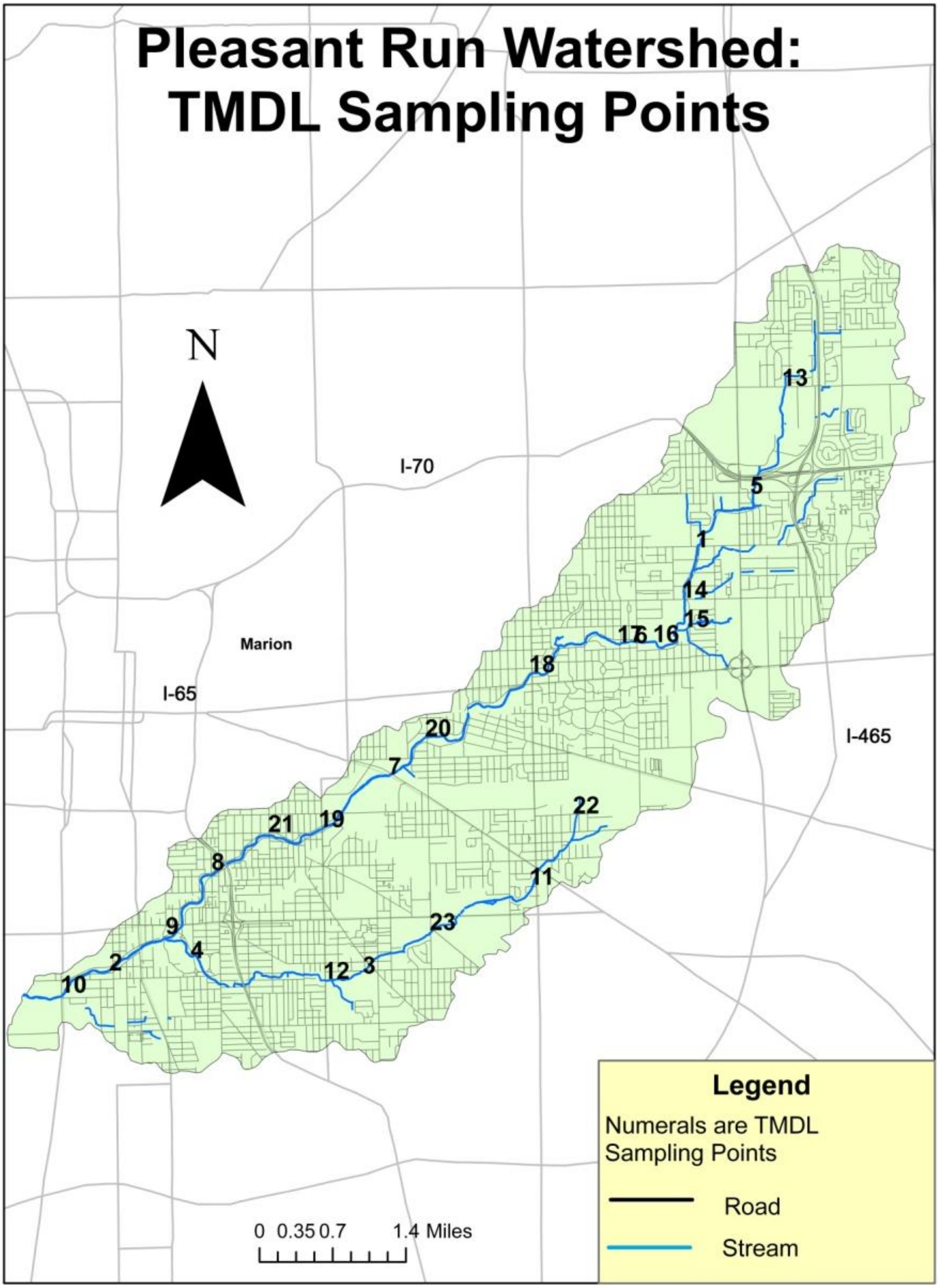
[19] Save the Dunes' Salt Creek WMP
[20] ibid

Parameter	Background	Typical Sources	Sampled By	Frequency	Standard/Target
Dissolved Oxygen (DO)	The dissolved gaseous form of oxygen. It is essential for respiration of fish and other aquatic organisms. Fish need at least three to five mg/L of DO.	Excessive algae growth can over-saturate (greater than 100% saturation) the water with DO. Low DO caused by decomposing organic matter: typical sources being CSOs, septic systems, wildlife/pet waste.	MCHD	1-6 times a month at 9 sites (ongoing since the 1990s)	Indiana Water Quality Standard: Min: 4.0 mg/L Max: 12.0 mg/L
			DPW	Monthly at 4 sites (ongoing since the 1990s)	
Biological Oxygen Demand (BOD)	The amount of oxygen taken up by microorganisms that decompose organic waste matter in water. A high BOD indicates the presence of a large number of microorganisms, which suggests a high level of pollution.	Organic waste: Urban storm water, septic systems, CSOs, wildlife/pet waste.	DPW	Monthly at 4 sites (ongoing since the 1990s)	1-2=Very Good 3-5=Moderately Clean 6-9=Somewhat polluted 10 or more=Very polluted with organic waste
Unionized Ammonia (NH3)	Inorganic form of nitrogen	Septic systems and some industrial processes.	DPW	Monthly at 4 sites (ongoing since the 1990s)	Indiana Water Quality Standard: Range between 0.0 and 0.21 mg/L depending upon temperature and pH
Total Suspended Solids (TSS)	All particles suspended and dissolved in water.	Sediment from erosion and urban storm water, as well as organic matter and trash.	DPW	Monthly at 4 sites (ongoing since the 1990s)	IDEM draft TMDL target from NPDES rule for lake dischargers in 327 IAC 5-10-4 and monthly average for winter limits for small sanitary treatment plants: Max: 30.0 mg/L

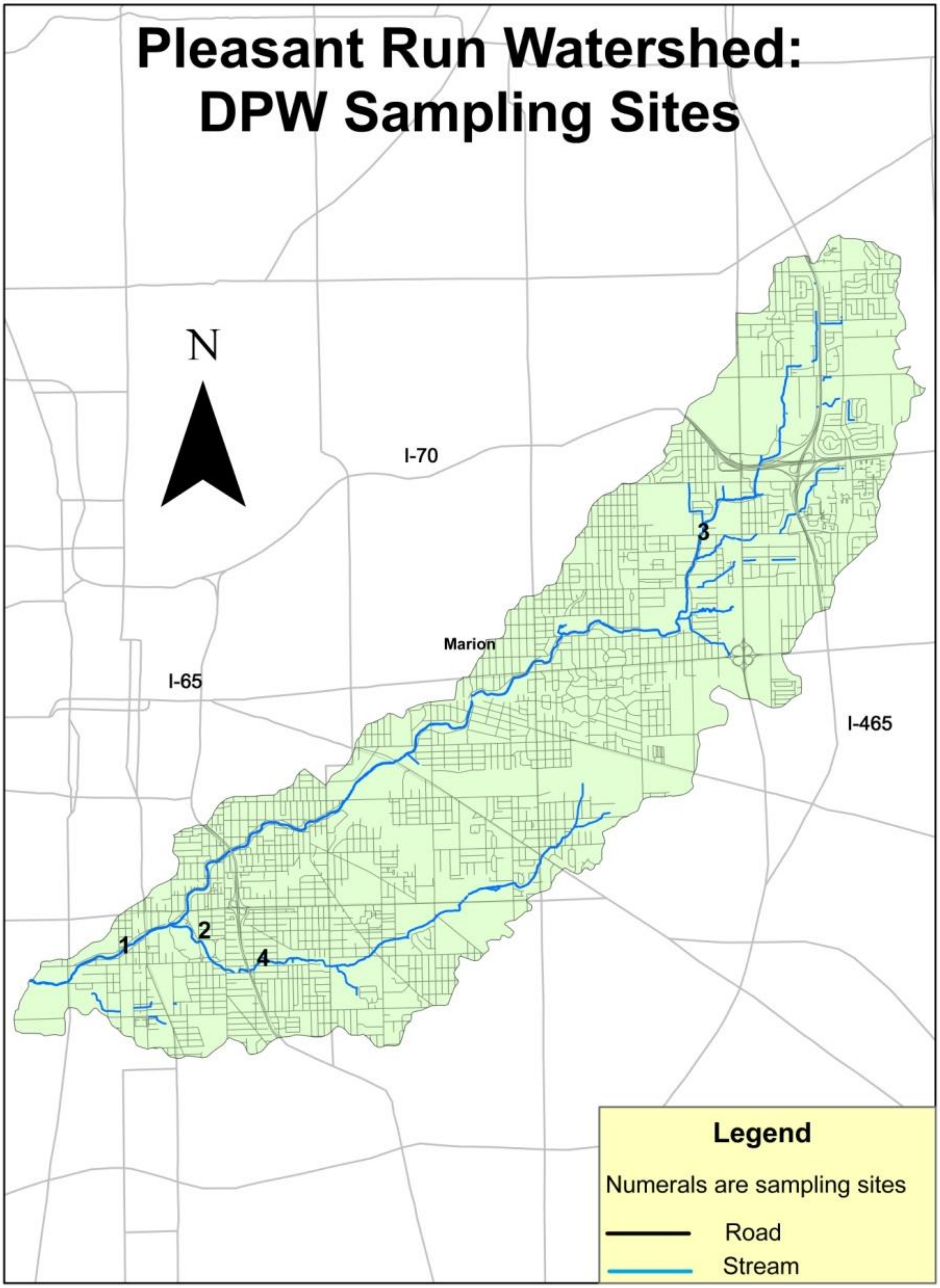
Parameter	Background	Typical Sources	Sampled By	Frequency	Standard/Target
Total Kjeldahl Nitrogen **(**TKN)	The sum of organic nitrogen, ammonia (NH3) and ammonium (NH4+) in biological wastewater treatment	CSOs, septic systems, wildlife/pet waste.	DPW	Monthly at 4 sites (ongoing since the 1990s)	U.S. EPA recommendation: Max: 0.591 mg/L
Nitrite (NO2)	Inorganic but in streams can come from oxidation of ammonia, which derives from organic decomposition.	CSOs, septic systems, wildlife/pet waste.	DPW	Monthly at 4 sites (ongoing since the 1990s)	Indiana Water Quality Standard: Max: 1 mg/L in waters designated as a drinking water source
Nitrate + Nitrite (NO2+3)	Naturally occurring inorganic ions that are part of the nitrogen cycle	CSOs, septic systems, wildlife/pet waste, and lawn fertilizers.	DPW	Monthly at 4 sites (ongoing since the 1990s)	Indiana Water Quality Standard: Max: 10 mg/L in waters designated as a drinking water source
Ortho-phosphate (Ortho-P)[21]	Soluble, inorganic form of phosphorus	CSOs, septic systems, wildlife/pet waste, and lawn fertilizers.	DPW	Monthly at 4 sites (ongoing since the 1990s)	Correll (1998): Max: 0.005 mg/L Correll, David L. 1998. The role of phosphorus in the eutrophication of receiving waters: a review. J. Environ. Qual., 27(2):261-266.
Total Phosphorus	A measure of both dissolved and particulate forms of phosphorus	CSOs, septic systems, wildlife/pet waste, and lawn fertilizers.	DPW	Monthly at 4 sites (ongoing since the 1990s)	U.S. EPA recommendation: Max: 0.076 mg/L

[21] For reasons unknown, DPW only samples Ortho-P in June and November. This reduced sampling decreases the certainty which conclusions may be drawn and precludes the comparison of wet and dry events. Despite this, Friends of Pleasant Run decided to present the Ortho-P data in the discussion about water quality. The small data set did make it difficult to calculate an Ortho-P load (6.1)

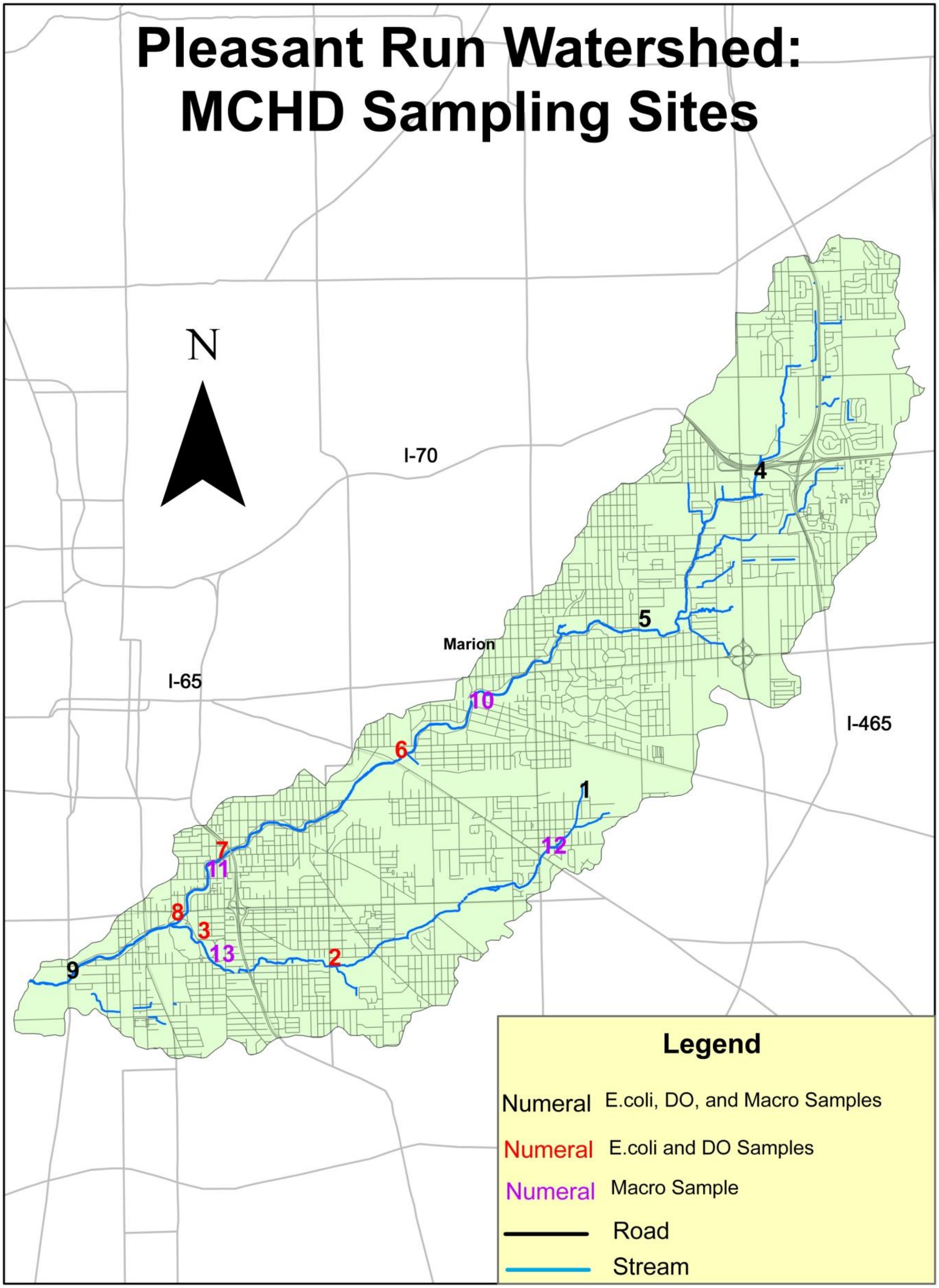
Map 16: TMDL Sampling Sites



Map 17: DPW Sampling Sites



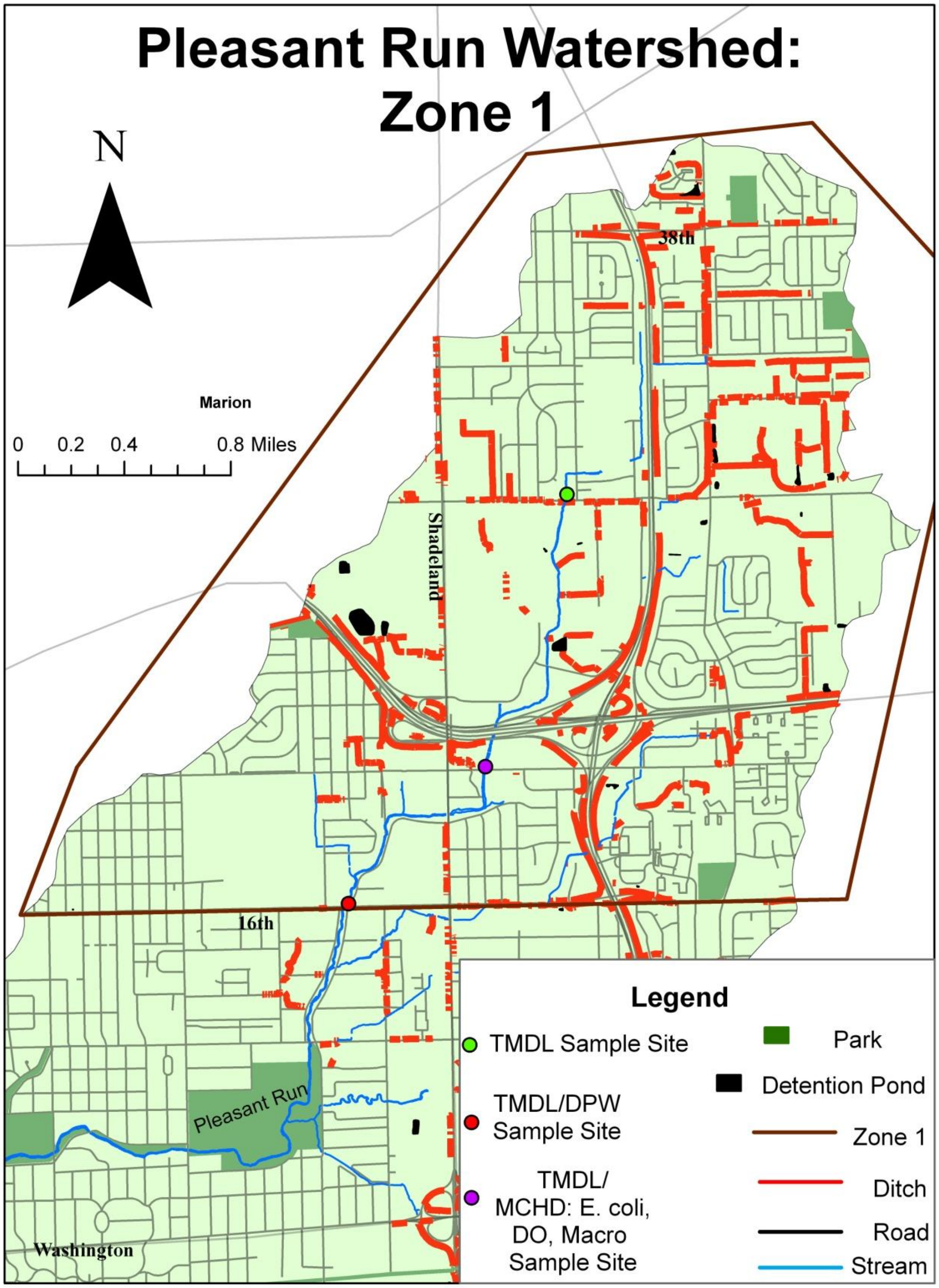
Map 18: MCHD Sampling Sites



3.3: Zone 1

Zone 1 lies to the north of 16th Street and includes the headwaters of Pleasant Run. Zone 1 has a DPW sampling site at 16th Street and an MCHD Macro, Dissolved Oxygen, and bacteria sampling site at 21st Street. During the TMDL study, IDEM used both of those sampling sites as well as a site at 30th Street.

Map 19: Zone 1



3.3.1: Zone 1 Water Quality Information

The data shows that E. coli, Ortho-P, Dissolved Oxygen (DO), and TKN exceed state water quality standards and/or benchmarks in Zone 1 of the watershed.

The TMDL best describes the scope of the E. coli problem. *Overall, the major findings are:*

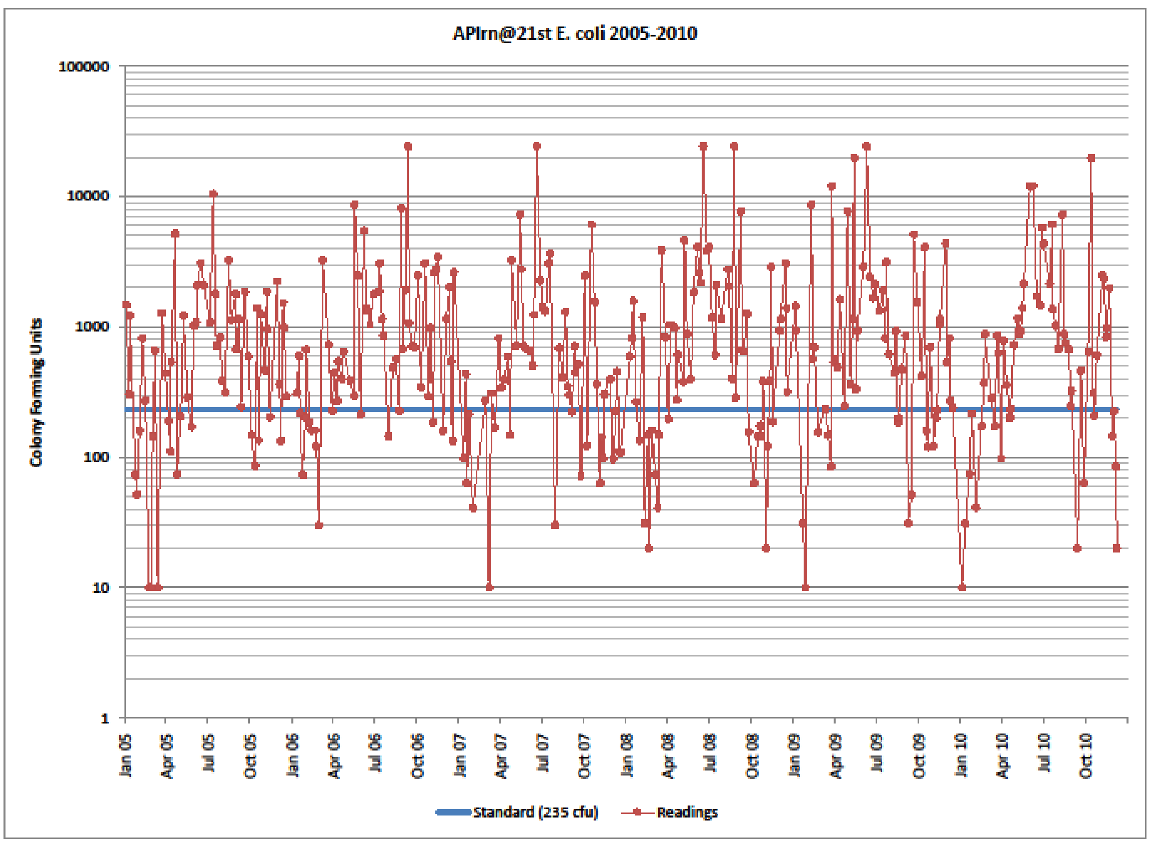
- *More than 90 percent of the sampling stations exceed the daily maximum E. coli bacteria standard (235 cfu/100 ml) more than 50 percent of the time.*

- *All of the sampling stations with sufficient data (5 samples in 30 days) exceed the geometric mean E. coli bacteria standard (125 cfu/100 ml) 100 percent of the time.*

In addition, the number of exceedances of the standard occurring upstream of the CSO segment is similar to the number of exceedances occurring within the CSO stream segment.[22]

The Marion County Health Department data probably best illustrates the long term E. coli trend at 21st Street.

Figure 9: MCHD E. coli Data Pleasant Run at 21st Street



[22] IDEM, Pleasant Run and Bean Creek TMDL pg 3-4

The MCHD data shows that very few of the samples meeting the water quality standard were taken during the recreational season (April through October) when people would most likely come in contact with the water (Figure 9). As Figures 10 and 11 show, no matter the weather conditions, the stream does not meet the water quality standard, although the problem worsens during wet weather. One wet weather E. coli source could be domestic and wild animal feces washed into the streams from detention ponds, lawns, and other open spaces.

Figure 10: Wet Weather E. coli data from DPW 16th Street Site

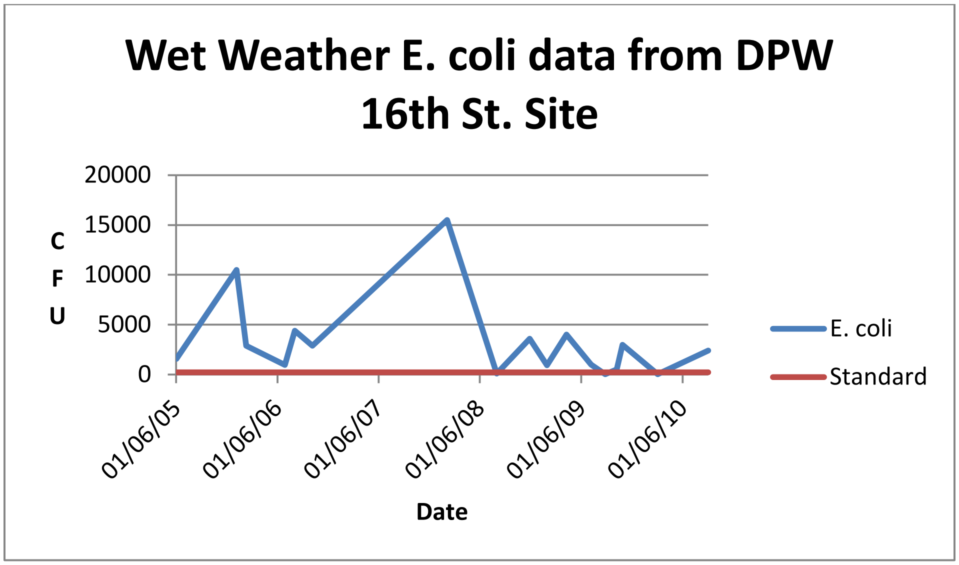
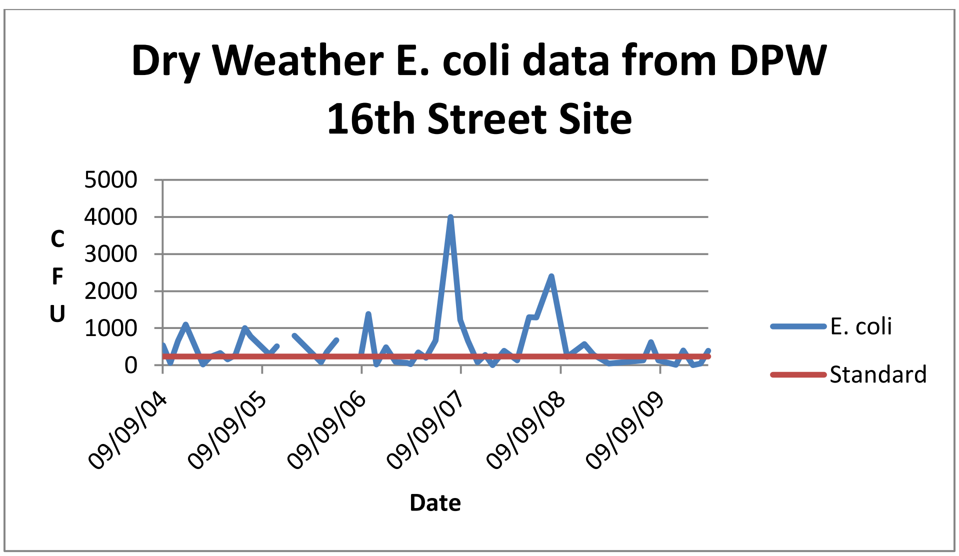


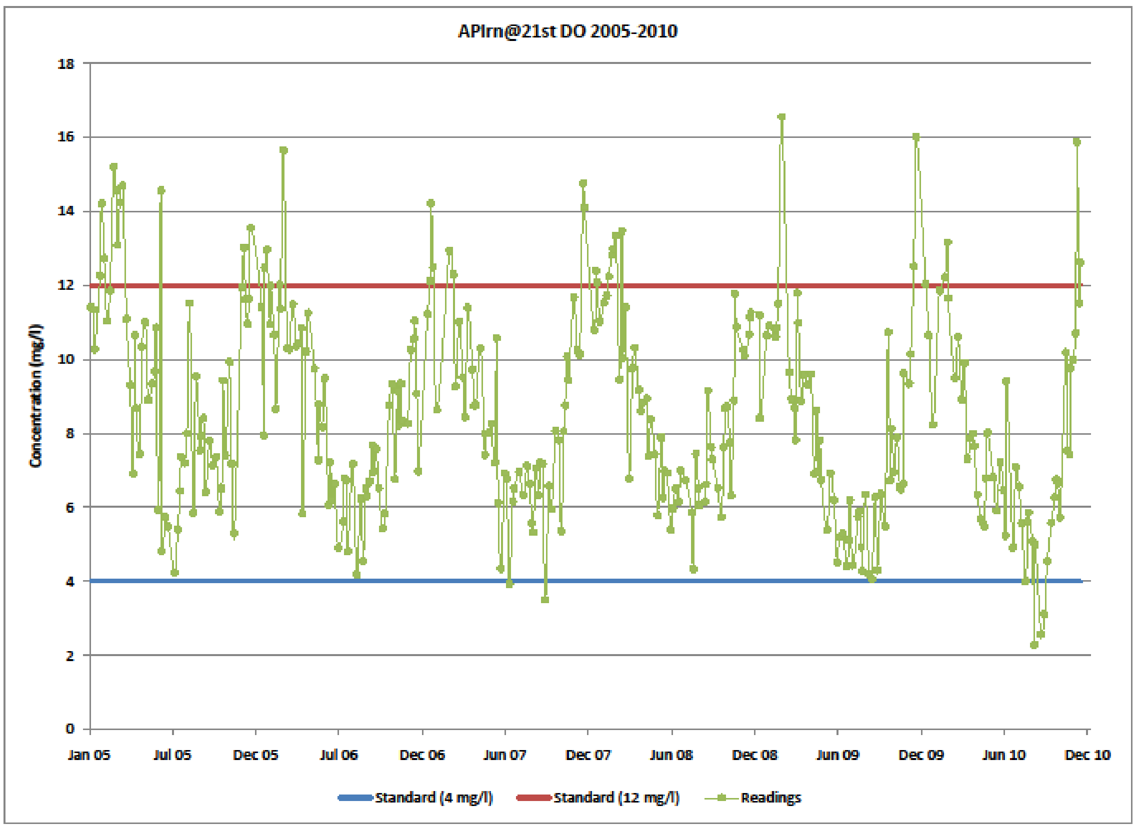
Figure 11: Dry Weather E. coli data from DPW 16th Street Site



Ortho-P levels in Zone 1 are also high. The median Ortho-P result for Zone 1 is 0.03 mg/l. The benchmark is 0.005 mg/l. A typical Ortho-P source is lawn fertilizer, but without a more robust sample set, it's impossible to say with any certainty if fertilizer is the source in Pleasant Run Watershed. Other sources may include septic systems and animal waste.

The Marion County Health Department's DO data clearly shows seasonal variations and violations of the maximum and minimum water quality standard. Organic matter from sources such as septic systems and pet and wildlife waste influence DO, and while these sources may influence the water quality, the violations shown on Figure 12 might be caused by the natural environment. Cold water holds more DO than warm water, so the spikes in DO concentration during the winter months are not unexpected. Likewise, the low concentrations seen every summer when levels dip close to or below the water quality minimum (4.0 mg/L) are perhaps explained by the temperature increase during that time of year. The amount of water in the stream may also be influencing the summer DO concentration. Turbulent water holds more DO than slow moving or stagnant water, and by late summer the lack of rain can cause Pleasant Run to run low. These environmental factors may influence the DO concentrations at 21st Street. However, 21st Street has the lowest DO concentrations of anywhere on Pleasant Run; suggesting that despite the natural influences on DO, work to reduce anthropogenic causes may benefit the headwaters and the rest of the stream.

Figure 12: MCHD DO Data Pleasant Run at 21st Street



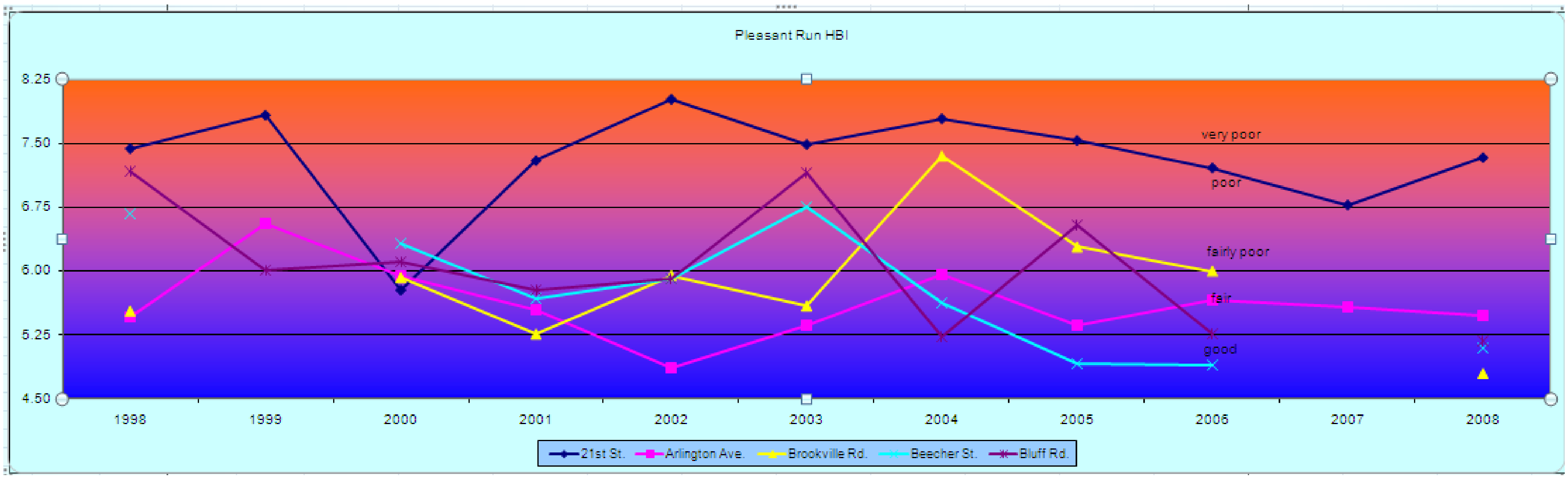
As Map 13 shows, there are septic systems in Zone 1. Septic systems are a common source of TKN and contribute NPS pollution regardless of the weather. It's no surprise then that the wet and dry TKN medians (0.66 mg/l and 0.62 mg/l respectively) are so similar. These values exceed the 0.591 mg/l benchmark.

3.3.2 Zone 1 Biological Information

MCHD has one sampling site—at 21st Street—in Zone 1. The macroinvertebrate scores consistently rank 'poor to very poor' which is indicative of organic pollution. There are no CSOs upstream of 21st Street. Likewise, there are no known septic systems upstream of the sampling site, but septics and their typical indicators—TKN and BOD--, can't be ruled out as a cause of the poor macroinvertebrate scores. The sampling site's only known source of organic pollution is storm water. As detailed below, Zone 1 has numerous landuses with little permeability. The area upstream of the sampling site has 23 storm water ponds, and these ponds collect organic waste from geese and other wildlife.

Poor macroinvertebrate habitat at 21st Street may also be contributing to the poor scores. Robust macroinvertebrate populations need a streambed with areas of rocks and gravel to thrive. Eroded sediment deposited on the stream-bed can smother bottom-dwelling communities and alter habitat by filling in holes and depressions. Suspended solids can reduce light penetration and therefore limit photosynthesis, with consequences for macroinvertebrate diversity and numbers. Total Suspended Solids data did not approach the benchmark in Zone 1 or any other part of Pleasant Run Watershed, so we can't say with certainty that sediment is damaging the habitat. Unfortunately, MCHD didn't measure habitat at any of their sites, so the influence of nearby bank erosion or other sediment sources can't be hypothesized. We do know there are several sediment sources in Pleasant Run Watershed. These include construction sites, eroding ditches and stream banks, and areas where invasive species have left the ground devoid of vegetation and susceptible to erosion.

Figure 13: MCHD Macro Data



3.3.3: Zone 1 Landuse Information

Zone 1 is residential from its northern tip near 38th Street south to 30th Street. From that point south to 21st Street, Zone 1 is dominated by warehouses, office buildings, car dealerships and other large commercial operations. This area has a high intensity of impervious surfaces, detention ponds, and also includes the junction of Interstates 70 and 465. The southern part of Zone 1 becomes residential again, includes one STEP neighborhood, and is home to Raytheon Corporation—a 5 square block campus with large parking lots and buildings but also large grassy fields. The concrete channel tributary to Pleasant Run discussed (2.3.4) originates from Raytheon property. Shirley Lake dam also sits in the southern part of Zone 1. While not much is known about the dam and its impact on water quality, it clearly is a barrier to aquatic life moving upstream. A final important aspect in Zone 1 is north to south running Shadeland Avenue. Shadeland's frontage is filled with strip malls, restaurants, car dealerships, and large commercial properties. Illegal dumping occurs where Pleasant Run intersects Shadeland Avenue.

Indy Parks in Zone 1 include Franklin and 38th Street Park, Windsor, Greene, and part of Dubarry. Although the Indy Parks Greenway doesn't extend into Zone 1, the main stem of Pleasant Run and many of its tributaries are still well buffered.

Map 15 shows there are some areas in Zone 1 where the buffer could be improved:

- Upstream of 34th Street
- Between N. Richard Avenue and 34th Street
- Between 30th Street and the Railroad Tracks
- Along Shibler Dr.
- Along portions of Western Select Dr.
- Portions of Warren Creek from its head down to 16th Street

Likely because of the hydric soils and their ability to hold water, Zone 1 has more drainage ditches than anywhere else in the watershed. Large ditches exist along Franklin Road and Shadeland Avenue and smaller ditch networks are spread across the residential areas. The windshield survey showed that the Shadeland Avenue ditches appear stable, but the ditches along Franklin Road show signs of erosion. One Franklin Road ditch has recently been dredged, indicating that it had filled with sediment and the city was concerned about water backing up.

Plate 22: Franklin Road Ditch

Plate 23: Cleaned Franklin Road Ditch

Appendix E shows areas of erosion along the stream banks. During the windshield survey, erosion was also commonly found below storm water pipes in all parts of the watershed, not just Zone 1.

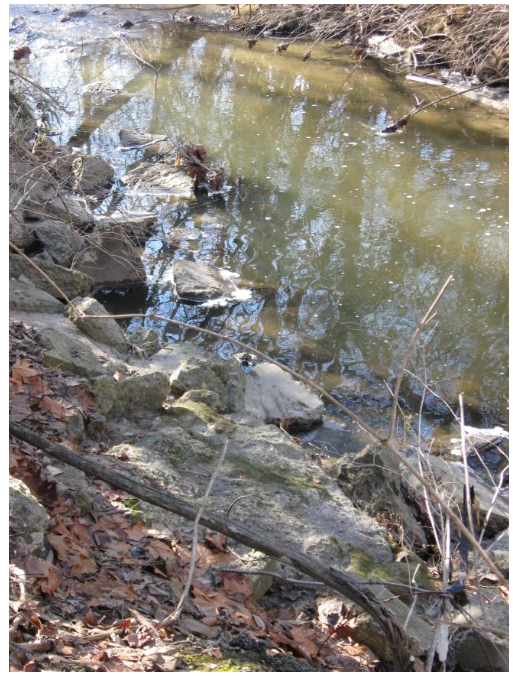
Plate 24: Storm Water Erosion from I 465

Plate 25: Storm Water Erosion from a Parking Lot Drain

Storm water pipes also directly outlet into the watershed's streams (Plate 26). All this added storm water increases the stream's flow, thereby adding erosive power that eats away at the stream banks. Concrete slabs have been placed across the watershed to help hold the banks in place (Plate 27). Since the soils along the stream bank are not highly erodible, the concrete likely wouldn't be necessary if not for the increased flow from storm water. Rather than emptying into the stream, if some of these pipes were redirected into a bioretention cell bank erosion might decrease. Room may exist along the stream between 16th and 21st Streets to add bioretention cells.

Plate 26: Storm water Pipe and Eroding Stream Bank

Plate 27: Concrete along Stream Bank



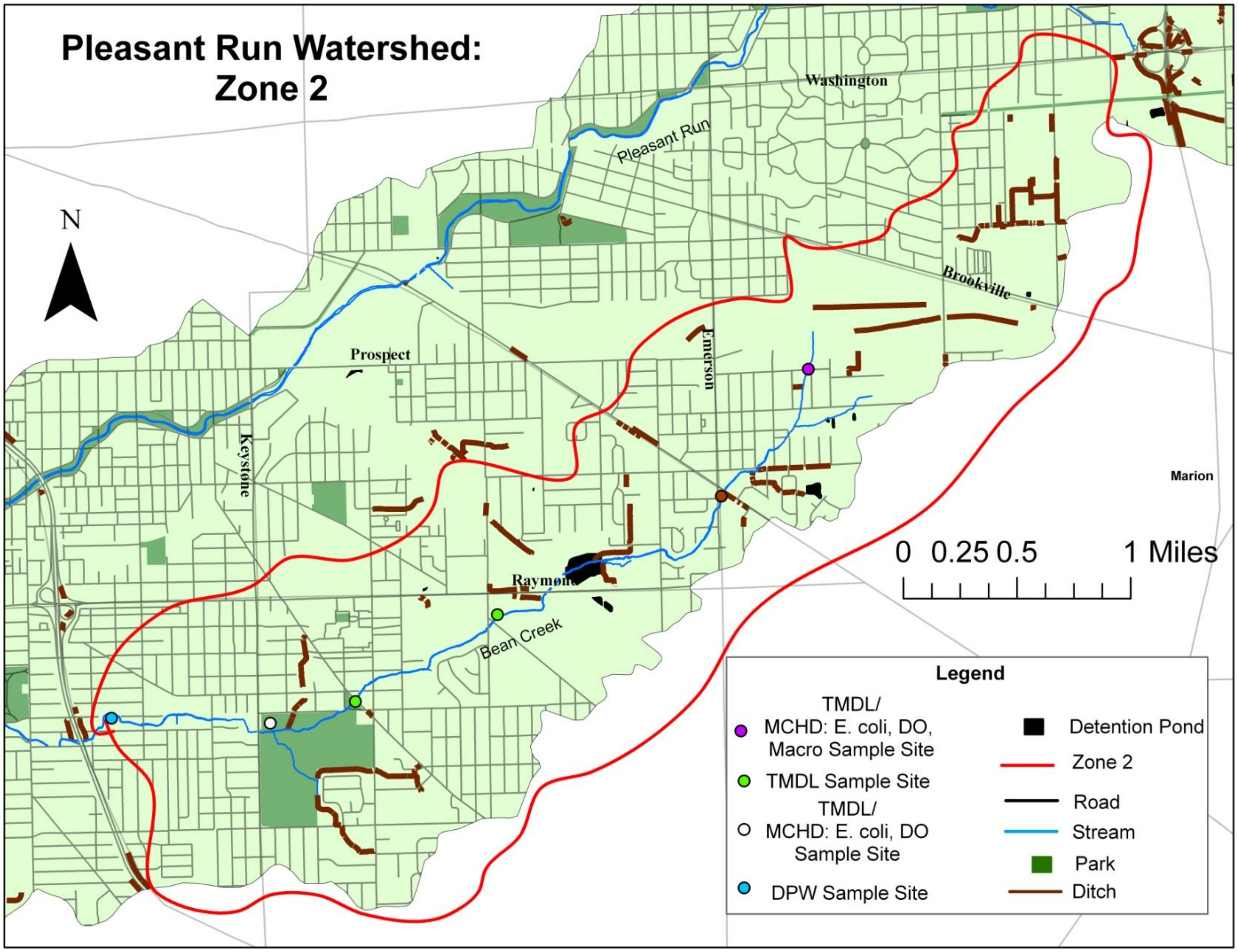
Zone 1 has the greatest amount of hydric or partially hydric soil in the watershed, and some storm water could be held back and infiltrated into the ground if some of those soils were returned to wetlands. However, the amount of urban development will make that work difficult. There are still some open spaces that overlap with hydric or partially hydric soils:

- Green space at Franklin and 38th (Indy Parks Property)
- Dubarry Park
- Portions of Windsor Village Park
- Wooded area around detention pond just east of Windsor Village Park
- Portions of the Raytheon Property
- Site 9 from Appendix C, northwest of the intersection of I 70 and Shadeland Avenue potentially is a natural wetland (existing wetlands should be preserved and can't be used to cleanse storm water)
- Site 13 from Appendix C, west of I 465 and north of 30th has existing wetlands (existing wetlands should be preserved and can't be used to cleanse storm water)

3.4 Zone 2

Zone 2 is an estimate of Bean Creek's watershed from that stream's headwaters to the DPW sample site at Southern Avenue and Bean Creek. MCHD has E. coli and Dissolved Oxygen sampling sites at Orange Street (in the headwaters) and at Keystone Avenue. During the TMDL study, IDEM used the Keystone Avenue sampling site as well as one at Emerton Place, which is just downstream from a MCHD macroinvertebrate site at Brookville Road

Map 20: Zone 2

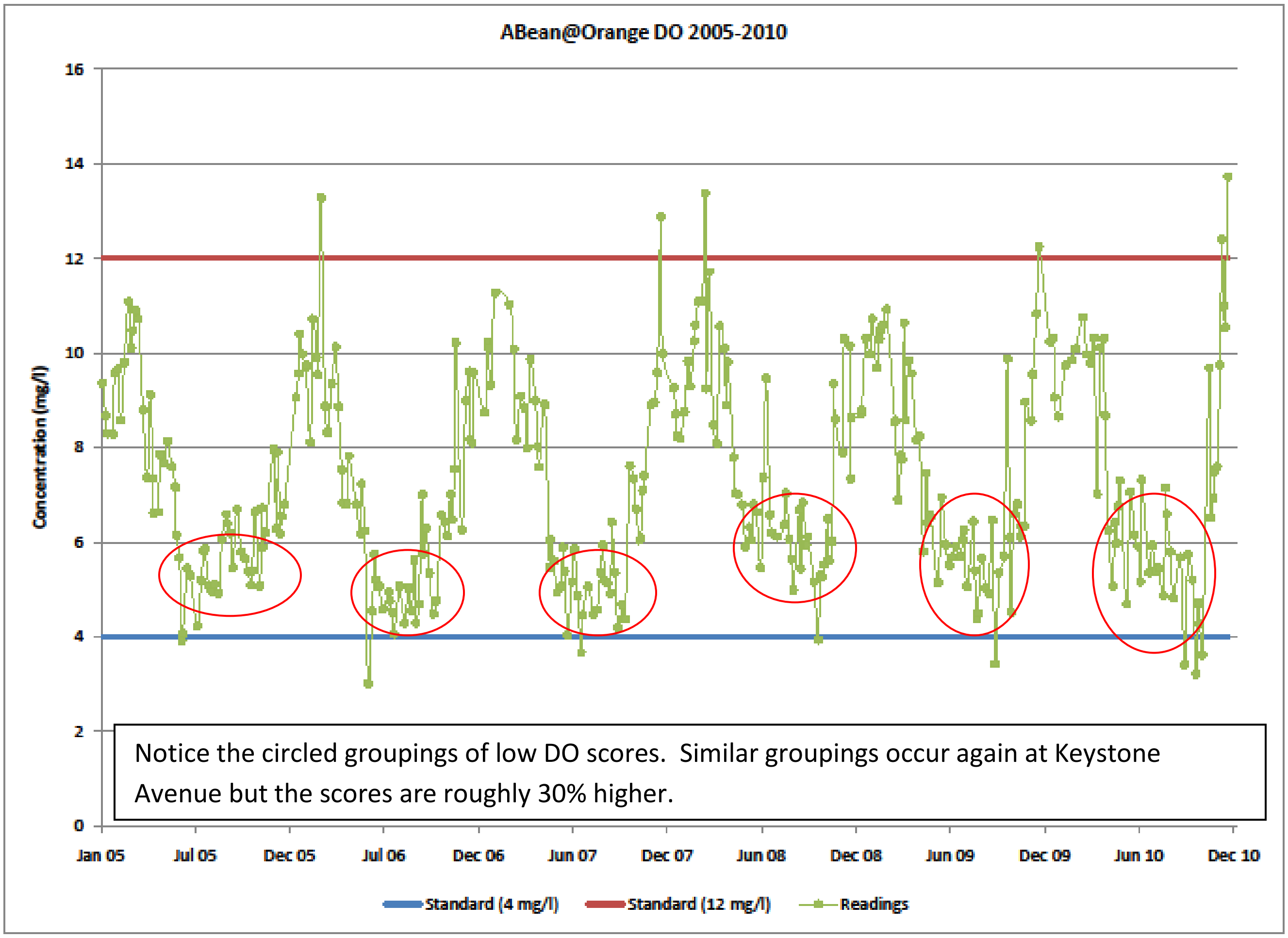


3.4.1 Zone 2 Water Quality Information

The data shows that DO, E. coli, and Ortho-P exceed state water quality standards and/or benchmarks in Zone 2 of the watershed.

Zone 2's first sampling site is a MCHD DO and E. coli site at Orange Street. DO shows the same seasonal variability and violations of the water quality standard as in Zone 1. The E. coli results were similar to Zone 1 as well. Bacteria counts tended to meet the water quality standards only from November to March, although exceedances were common during these months too. Possible sources of DO and E. coli exceedances at Orange Street include six upstream STEP neighborhoods and the 5 detention ponds in Bean Creek's headwaters, which begins just west of the intersection of Shadeland Avenue and Washington Street.

Figure 14: MCHD DO Data Bean Creek at Orange Street



MCHD also has a sampling site at Keystone Avenue. E. coli results at Keystone Avenue show the same trends seen at Orange Street and Zone 1 (Figure 16). The DO data has the same familiar seasonal pattern, but at Orange Street the groupings of low DO were in the 4-6 mg/L range (Figure 14), and at Keystone Avenue low DO scores were in the 6-9 mg/L range (Figure 15). Despite the many STEP neighborhoods in Zone 2, DO increases between Orange Street and Keystone Avenue. There is no clear evidence for that increase.

Figure 15: MCHD DO Data Bean Creek at Keystone Avenue

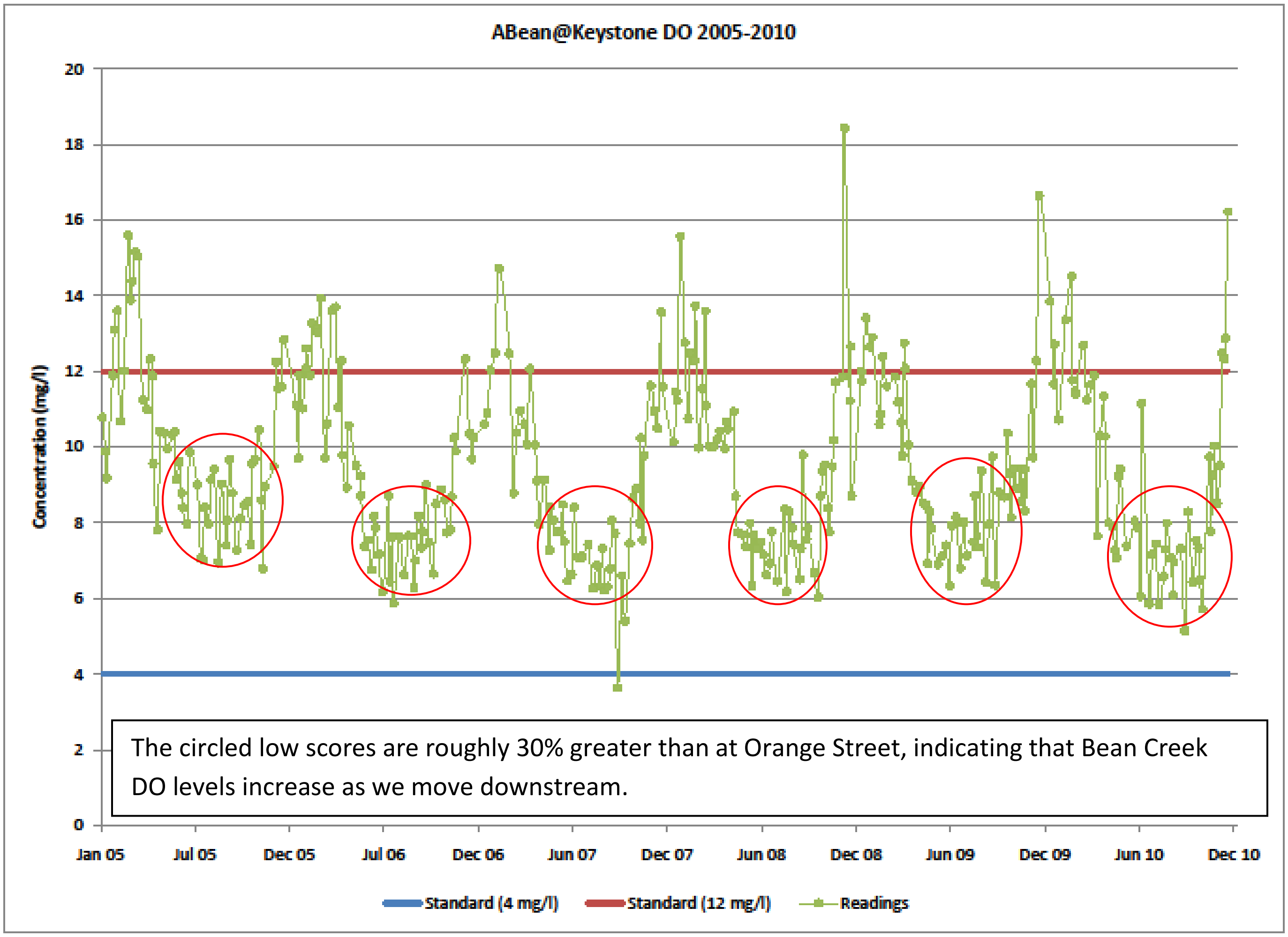
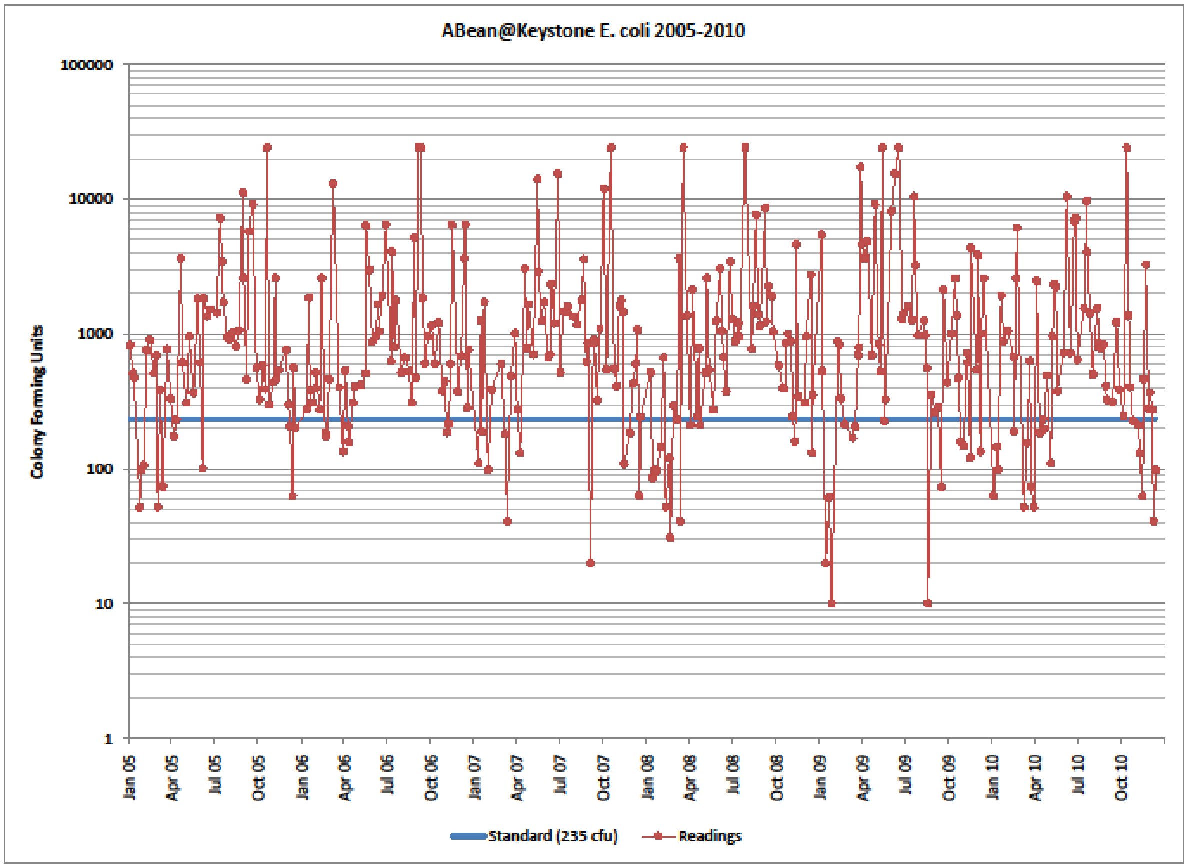


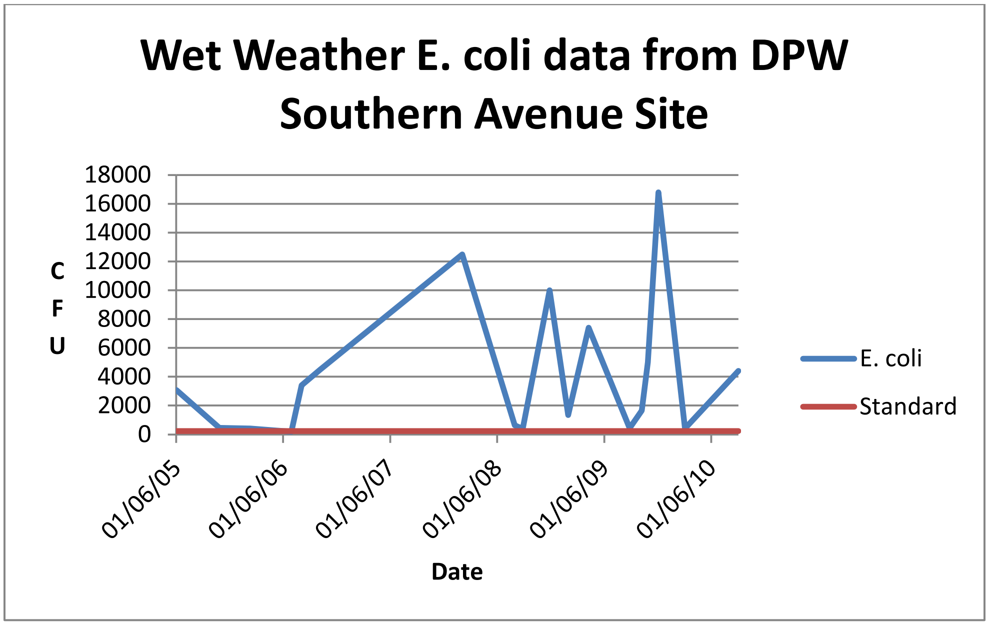
Figure 16: MCHD E. coli Data Bean Creek at Keystone Avenue

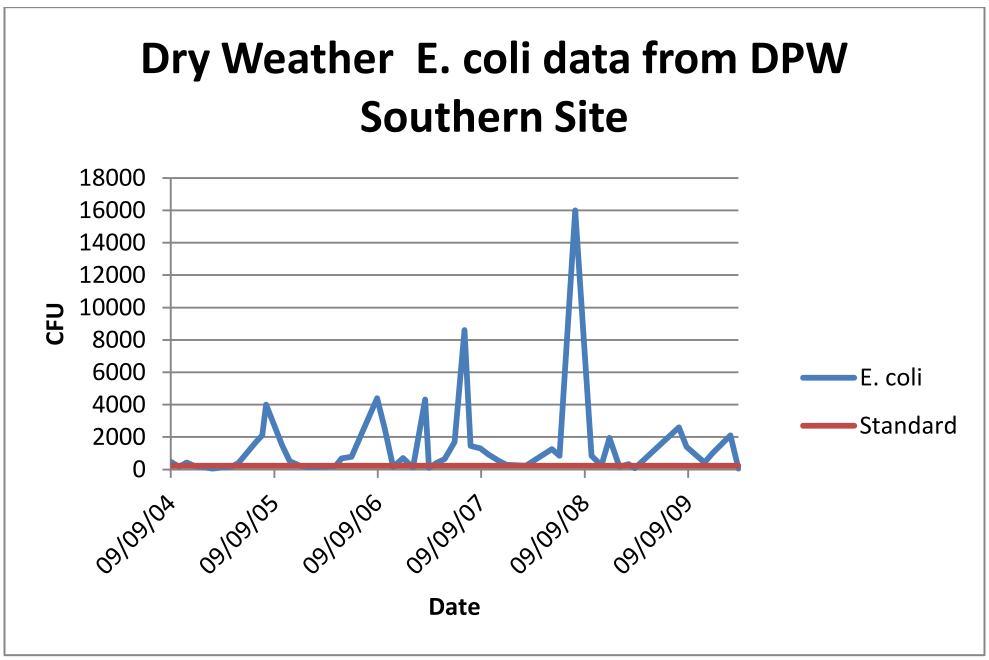


Downstream of Keystone Avenue is DPW's sampling site at Southern Avenue. Data at Southern Avenue shows how wet weather impacts water quality in Zone 2. BOD, TKN, and Total Phosphorus' median values all increase during wet weather (by 100%, 21%, and 50% respectively). None of these increases surpass water quality benchmarks, but they do suggest that storm water and organic pollutants such as lawn fertilizers and pet and wildlife waste have an impact on water quality.

As shown in Figures 14 and 15, E. coli values at Southern Avenue exceed the water quality standard regardless of the weather. Septic systems are a likely cause, and there are STEP neighborhoods near the Southern Avenue sampling site. Other possible sources include pet and wildlife waste.

Figures 17 and 18: Wet and Dry Weather E. coli data from DPW Southern Avenue Site



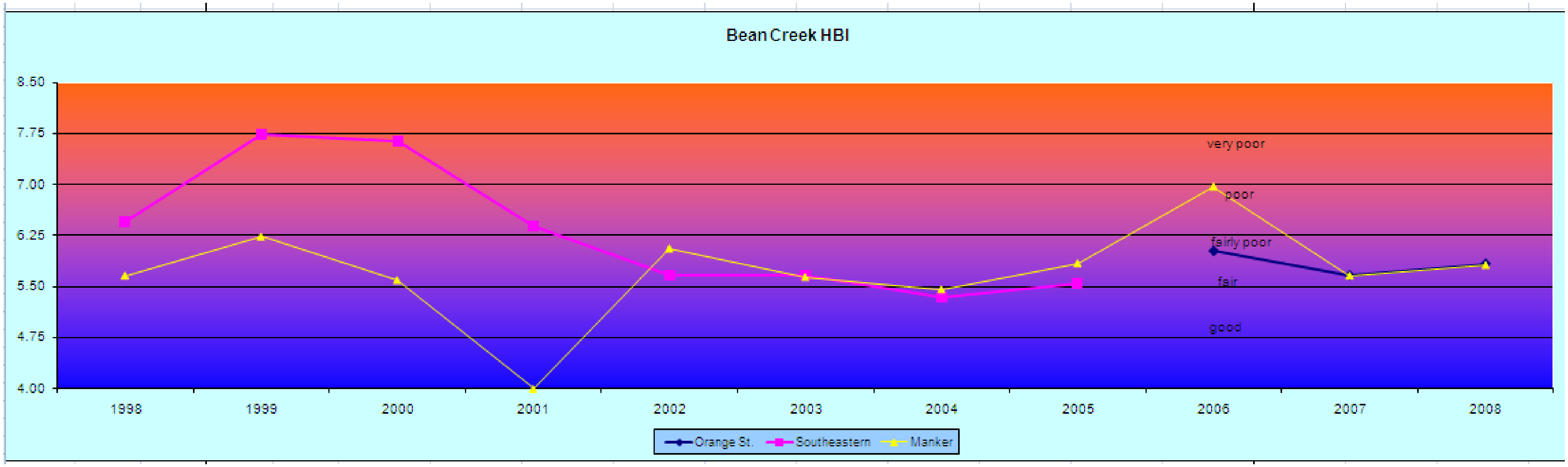


Ortho P at Southern Avenue also exceeds its water quality benchmark (0.005 mg/L). Median Ortho P concentration is 0.03 mg/L. Possible sources include septic systems and the runoff of fertilizer and pet/wildlife waste.

3.4.2 Zone 2 Biological Information

MCHD has two macroinvertebrate sampling sites—Orange Street and Southeastern Avenue—in Zone 2. The Orange Street site sits just downstream from where the creek daylights from under the Navistar complex and the Southeastern Avenue site is less than a mile further downstream. Bean Creek has intense hydrologic modifications upstream of Orange Street, but the site's scores are not as bad as one might expect. MCHD has data for 2006, 2007, and 2008. The scores range from 'fairly poor to fair'. The Southeastern Avenue site doesn't have data past 2005, but available data shows macroinvertebrate scores trending towards ‘fair’. Like Zone 1, drawing conclusions from the macroinvertebrate data proves difficult. There are no CSOs upstream of these sites, but there are neighborhoods on septics and as noted the headwaters have undergone intense hydrologic modification. The age of the data also makes it difficult to surmise what current conditions may be.

Plate 28: Bean Creek Macro Scores



3.4.3 Zone 2 Landuse Information

Zone 2 contains Bean Creek's headwaters and begins just west of the intersection of Shadeland Avenue and Washington Street. A series of ditches between Washington Street and Brookville Road make up the headwaters (see Map 4). The ditches drain the Ford Component Factory (closing in 2011), a .5 mile square site, and other commercial sites. There is a 300' x 300' retention pond at the northwest corner of the Ford property that does not appear on the GIS.[23] Once Bean Creek leaves this heavily developed area, it enters an underground pipe at Southeastern Avenue and travels underneath the Navistar Plant. The plant was scheduled to close on July 31, 2009 due to the loss of a contract with Ford. However, it will continue production of engines for Navistar with a current workforce of about 250 people. Bean Creek continues underneath the CSX Rail Yard (discussed as part of Zone 3) and finally emerges in a residential area. From there, Bean Creek meanders southwest, through a large green space north of Raymond Street where the city is planning a storm water project and past commercial areas south of Raymond Street. Other than the headwater area, Raymond Street is the most commercial/industrialized part of Zone 2. The street is home to a large complex of grain silos, light industry, and a network of roadside ditches. Once past the Raymond Street area, Bean Creek flows back into residential neighborhoods and into Sarah Shank Golf Course where it's joined by a regulated drain named Sarah Run. Once it leaves the golf course, Bean Creek flows through more residential areas and exits Zone 2. Parks in Zone 2 include Sarah Shank Golf Course, Red Maple, and part of the Pennsey Trail.

[23] Navistar information courtesy of Bob Sweet

Most of Bean Creek passes through private residential land while most of Pleasant Run runs through city owned parks and the Indy Parks Greenway. Bean Creek's residential neighborhoods provide a tremendous opportunity to educate about reduced lawn fertilizer, storm water retention, and ways to improve the stream buffer, which for large parts of Zone 2 passes through people's backyards. Map 15 shows the stream buffers in Zone 2 and suggests buffers could be improved:

- Between Orange and Terrace
- South of Reeder
- East of Sloan
- North of Emerton Place
- Between Finley and Walker
- Sarah Shank Golf Course

Zone 2 has Highly Erodible land in the headwater's region, but the majority of the zone is Potentially Highly Erodible. The stream banks themselves are not classified as erodible. Eroding stream banks is a public concern. The windshield survey and Appendix E indicate that stream bank erosion is not as serious a problem along Bean Creek as it is along Pleasant Run. This assumption is based on the maps but also the absence of concrete blocks along Bean Creek's banks. As noted in Section 3.3.3 and 3.5.3, the city has seemingly placed concrete blocks along Pleasant Run's banks wherever they had access. These blocks' purpose is to reduce bank erosion. In reality though, flowing water will get between and behind the blocks and continue to move sediment. These blocks are not found along Bean Creek until it enters Zone 3. Their absence may be a combination of soil characteristics and landuse—Zone 2 is primarily residential, a landuse that results in less storm water runoff. While Zone 2's stream banks did appear stable during the windshield survey (as compared to Pleasant Runs'), some areas of stream bank erosion are noted in Appendix E.

Zone 2 has all or part of six STEP neighborhoods. While the Zone's soils are unrated for septic suitability, these neighborhoods would not be scheduled for sewers if the city didn't believe their septic systems were failing. Once these six STEP projects are completed, a significant source of E. coli and TKN will be removed.

Zone 2 only has partially hydric soils, but these soils do overlap with some open space, creating opportunities to store and cleanse storm water naturally:

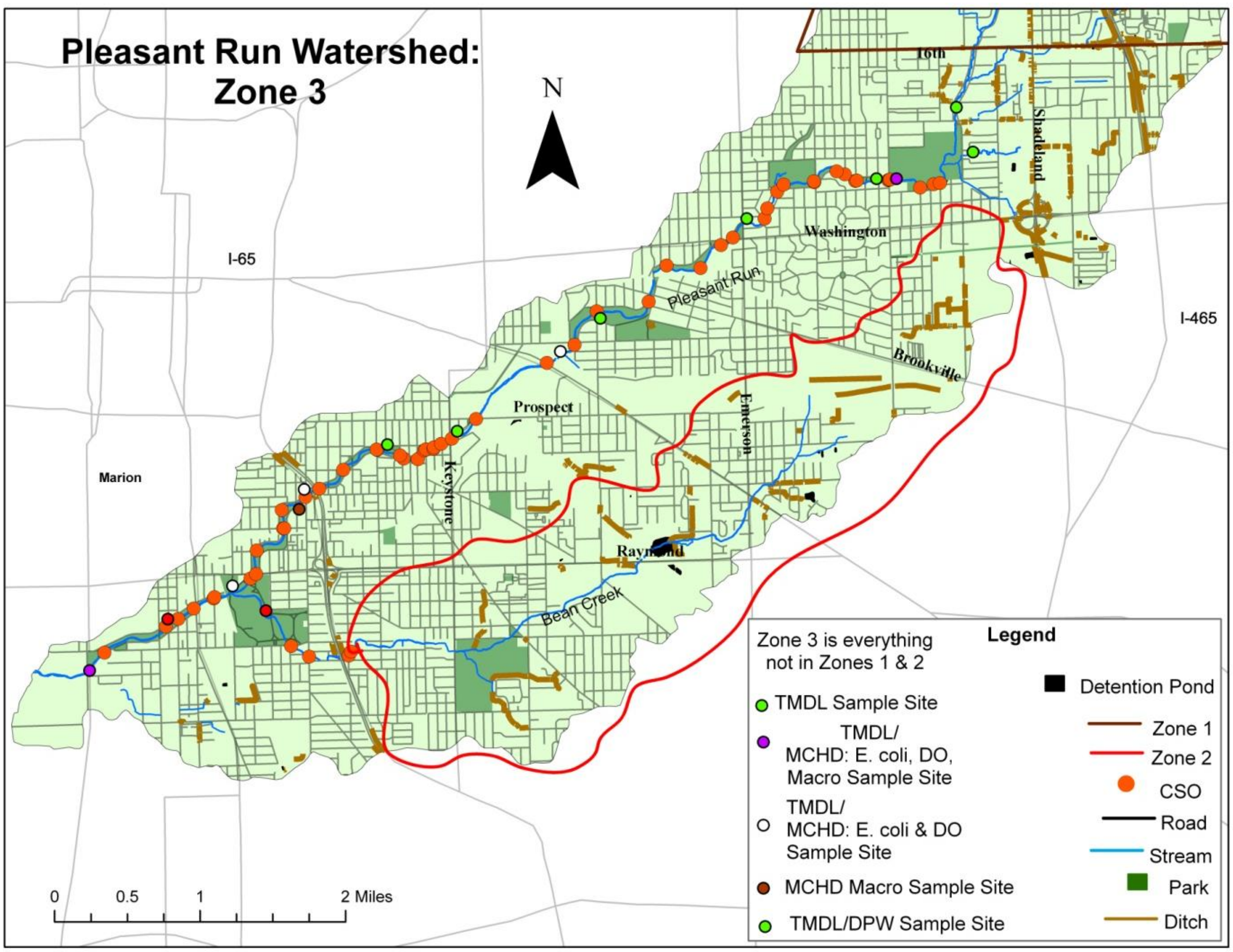
- Portions of the wooded area directly south of the Navistar Property and the abutting CSX Rail Yard
- The small wooded areas within the CSX Rail Yard, just west of Emerson Avenue
- Green space south of Minnesota Street and east of S. Irvington Avenue
- Green space between Emerton Place and Calhoun Street
- South of where Bean Creek crosses Raymond Street and north of Bethel Avenue
- Portions of Bethel Park
- Portions of Sarah Shank Golf Course

- Site 15 from Appendix C, potentially has natural wetlands on the north side of Raymond between Sherman Avenue and Sloan Street (existing wetlands should be preserved and can't be used to cleanse storm water)
- Site 6 from Appendix C, potentially has forested wetlands south of Terrace Road and north of Minnesota Road (existing wetlands should be preserved and can't be used to cleanse storm water)

3.5 Zone 3

Zone 3 starts south of 16th Street and encompasses the rest of Pleasant Run to its intersection with the White River as well as the part of Bean Creek not covered by Zone 2. The presence of CSOs in Zone 3 (see Map 21) helps differentiate it from Zones 1 and 2. Within Zone 3 DPW has sampling sites on Pleasant Run at Meridian Street and on Bean Creak in Garfield Park. MCHD has macroinvertebrate, E. coli, and dissolved oxygen sampling sites on Pleasant Run at Arlington Avenue, Southeastern Avenue, and Bluff Road and on Bean Creek at Manker. MCHD has a site just for macroinvertebrates on Pleasant Run at Beecher and sites just for E. coli on Pleasant Run in Garfield Park and at Barth Street. During the TMDL study, IDEM used all of the sites mentioned above except for Beecher. IDEM also sampled Pleasant Run at two sites at Pleasant Run Golf Course, at Emerson Avenue, Keystone Avenue, Sherman Drive, Southeastern Avenue, and State Street.

Map 21: Zone 3

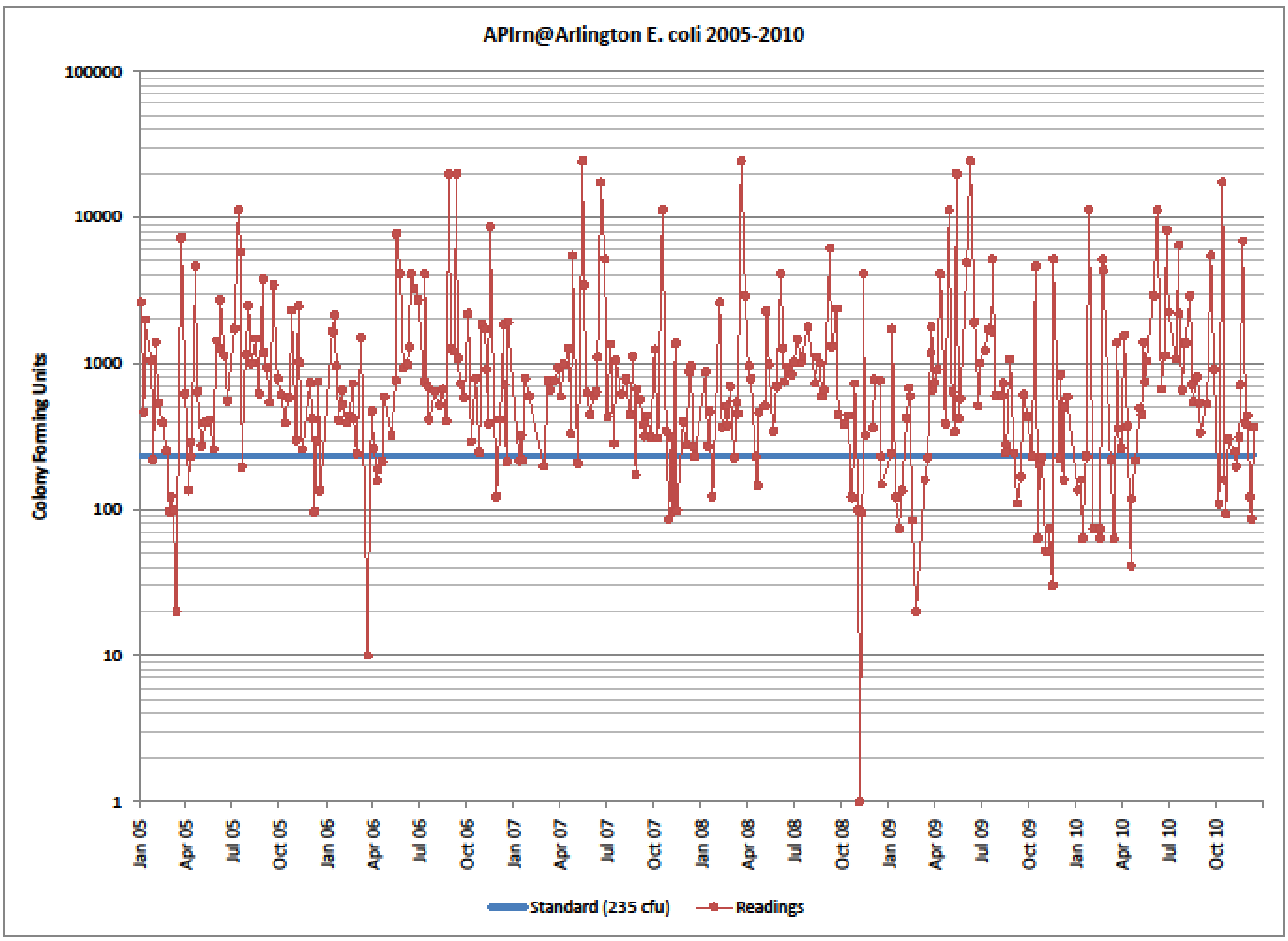


3.5.1: Zone 3 Water Quality Information

The data shows that DO, E. coli, Ortho-P, and TKN exceed state water quality standards and/or benchmarks in Zone 3 of the watershed.

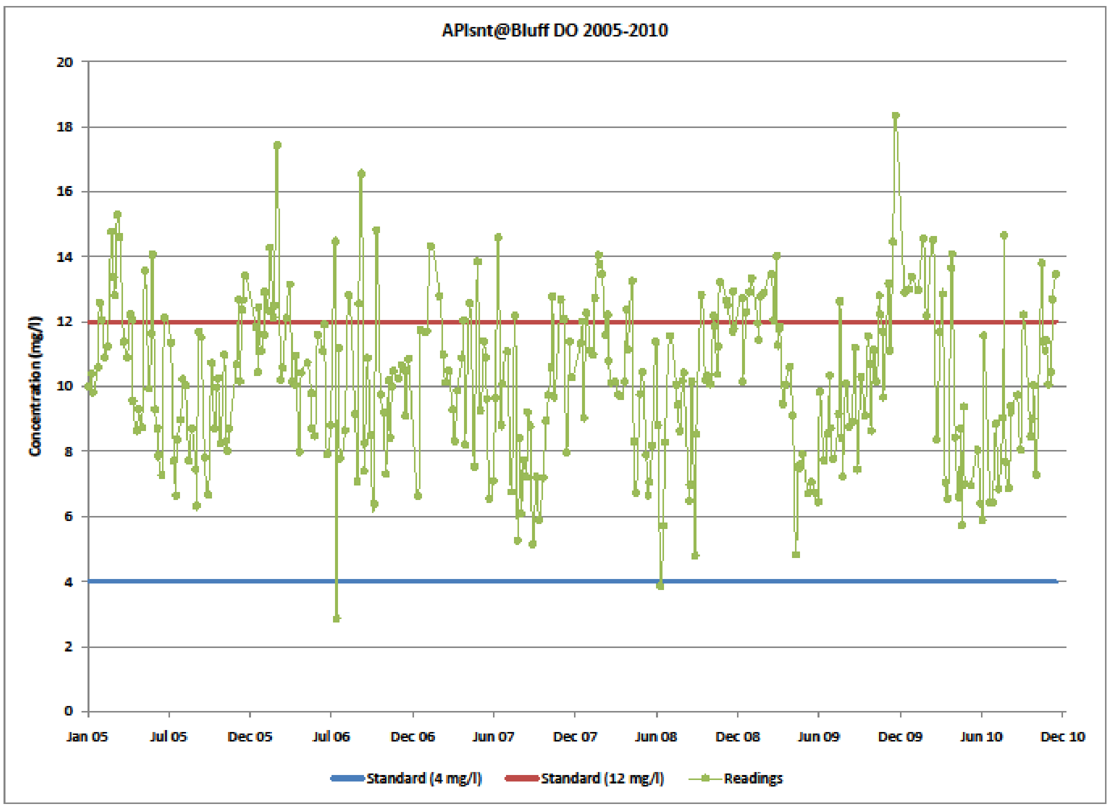
The first Zone 3 sampling site is a MCHD site on Pleasant Run at Arlington Avenue. The DO violations followed the seasonal pattern seen elsewhere in the watershed. The data tended to range around 7.0 mg/L and 12.0 mg/L during the summer and winter months respectively. 74% of E. coli samples at Arlington Avenue exceeded the water quality standard. As Figure 16 shows, most of samples over the water quality standard came during the winter months and hence are not an official water quality violation.

Figure 19: MCHD E. coli Data Pleasant Run at Arlington Avenue



Moving downstream, there are four more MCHD sites on Pleasant Run and they all exhibit the same DO and E. coli trends seen at Arlington Avenue. The one data set that shows some variability in DO at Bluff Road. As Figure 17 shows, DO at Bluff Road is still within expected ranges, but the ebbs and flows of the data due to the seasons is not as evident. A reason for this is not clear. It was expected that the CSOs might influence DO, but the data did not bear that out. The CSOs may have influenced E. coli data on Pleasant Run. Comparing data from 21st Street (not within the CSO area) with data from sites within the CSO area shows that on average there are 141% more samples above 10,000 cfu within the CSO area than outside it; however, this difference seems inconsequential when considering a water quality standard of 235 cfu.

Figure 20: MCHD DO Data Pleasant Run at Bluff Road



Zone 3's DPW sampling site on Pleasant Run is at Meridian Street. NH3, whose sources include septic systems and some industrial processes, has a median (0.20 mg/L) that nearly exceeds the water quality benchmark of 0.21 mg/L during dry weather. TKN at Meridian Street exceeds the benchmark (0.0591 mg/L). The median dry weather TKN value is 0.65 mg/L and this increases to 0.74 mg/L during wet weather. The dry weather exceedances may be linked to septics. The wet weather concentration obviously is runoff related and possible sources include pet and wildlife waste.

Ortho-P's median concentration at Meridian Street is 0.03 mg/L. This is identical to medians from Zones 1 and 2 and exceeds the benchmark of 0.005 mg/L. Total P is the final parameter to examine at Meridian Street. The water quality benchmark of 0.076 mg/L was never exceeded, but Total P was 50% higher during wet weather than dry weather. Possible wet weather Total P sources include lawn fertilizer and pet/animal waste.

Zone 3's DPW sampling site on Bean Creek is at Garfield Park. Like at Meridian Street, Total P did not exceed its benchmark, but its median concentration did increase 25% during wet weather. E. coli consistently exceeded its standard and showed similar trends to the other sampling sites in the watershed. Ortho-P's median concentration of 0.05 mg/L not only exceeded the benchmark, but was the highest median concentration of all Ortho-P sampling sites. Bean Creek's CSO area sits just upstream of Garfield Park so the natural inclination is to list that as the cause of the high Ortho-P samples. However, as mentioned, DPW did not sample as many Ortho-P wet weather events as they did for other parameters. In fact, since 2005 only 2 wet weather samples exist—one for 0.32 mg/L and one for 0.098 mg/L. Many more dry weather samples exist, so it's not conclusive that CSOs are causing the high Ortho-P median concentrations. Perhaps the STEP neighborhoods in Zone 2 are a factor.

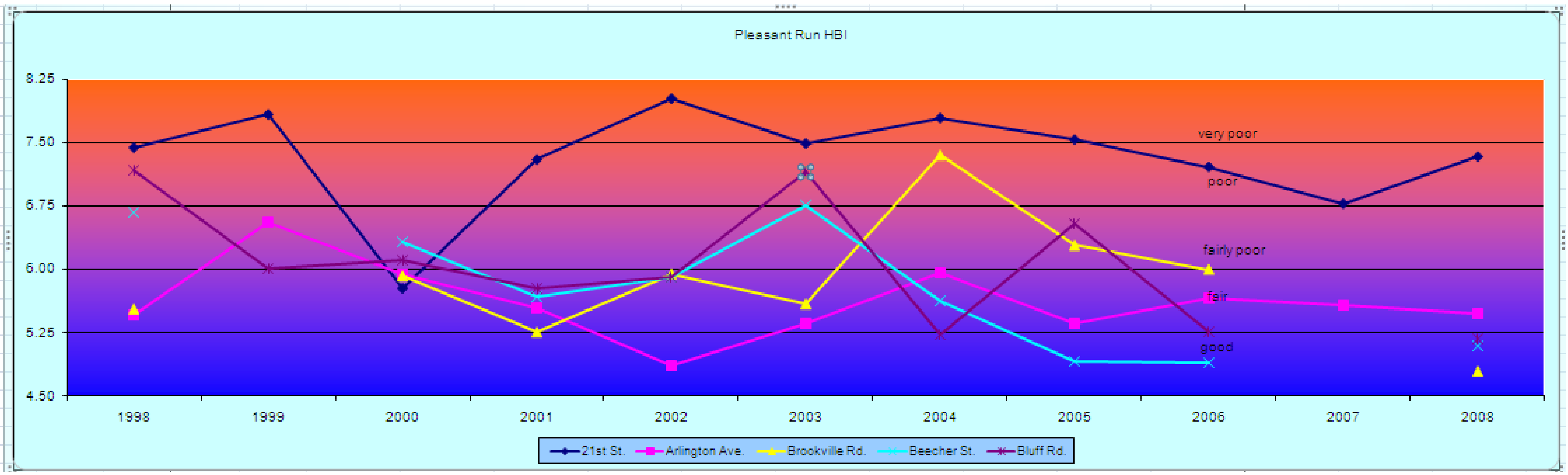
It was expected that, because of the CSOs, water quality from Zone 3 would be different than those in Zones 1 and 2. The data did not support this hypothesis. At all sites, whether for wet or dry sampling events, the data did not show many relative differences. Exceptions are E. coli, which was discussed above, and the Ortho-P results from Bean Creek at Garfield Park. That the influx of raw sewage and untreated storm water could not be seen in the data is further evidence that true wet weather samples are not in our data set, and the storm water influence on Pleasant Run Watershed's water quality is underestimated here.

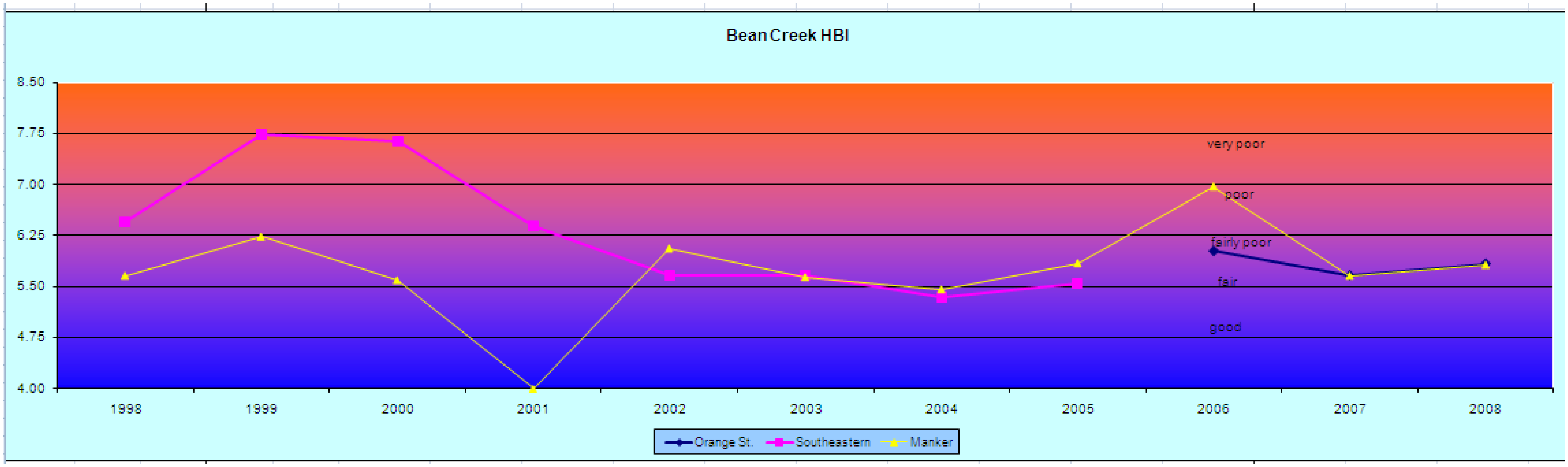
3.5.2 Zone 3 Biological Information

On Pleasant Run, the Arlington Avenue macroinvertebrate site has 'fair' scores. This site is just within the CSO area and downstream of a STEP neighborhood in Zone 1. The next downstream site, at Brookville Road trends 'poor' to 'fairly poor', and data doesn't exist past 2006. The Beecher Street site's data also ends at 2006, and at that point the scores were trending to 'good'. The last site on Pleasant Run, Bluff Road, consistently has 'fair' scores. The lone Bean Creek macroinvertebrate site in Zone 3 is on Manker Road, within the CSO area, and has consistently trended 'fairly poor'.

As discussed elsewhere, these scores are caused by a variety of factors. Storm water and stream bank erosion impact all these sites. The Arlington Avenue and Manker sites are downstream of STEP neighborhoods and receive constant organic pollution. All of the sites receive organic pollution during wet weather CSO events. Scores likely will not significantly improve until the sources of organic pollution—the septics and CSOs—are eliminated.

Plate 29: Zone 3 Macro Scores





3.5.3 Zone 3 Landuse Information

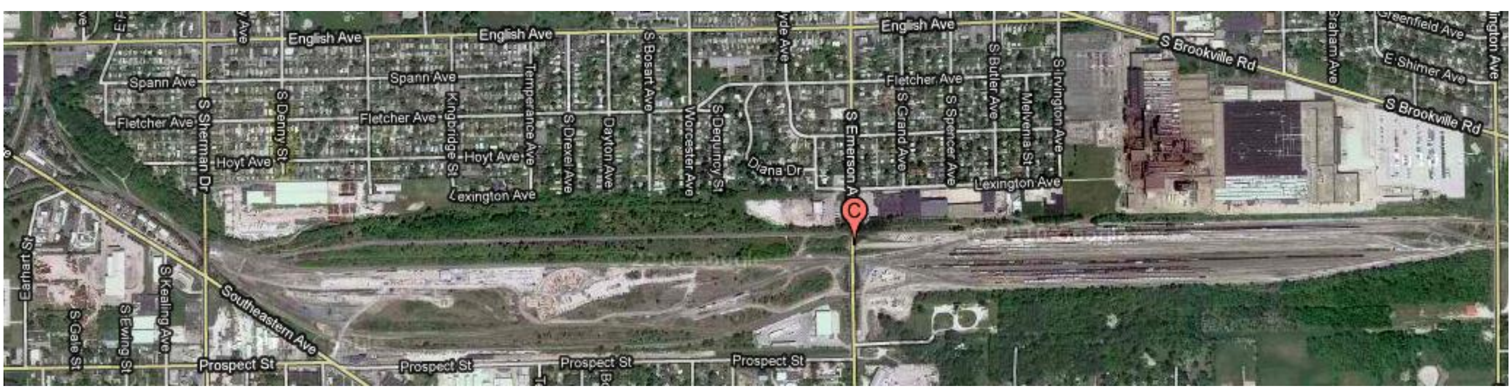
Zone 3 begins on the south side of 16th Street and continues to the mouth of Pleasant Run. Parks in Zone 3 include part of the Pennsey Trail, Ellenberger, Christian, Garfield, Bethel, Irvington Circle, the Pleasant Run Greenway, Sandorf, Orange, Clayton and LaSalle, and Pleasant Run Golf Course. Windshield surveys show that throughout Zone 3—as well as between 16th and 21st Streets in Zone 1—the city has placed concrete blocks along the banks. These are primarily in areas where the city has jurisdiction, like the parks, Indy Parks Greenways, and bridge crossings. However, since much of Pleasant Run and Bean Creek flow through city property in Zone 3, the concrete blocks are ubiquitous across this zone.

Plate 30: Example of concrete along Pleasant Run

The Shadeland Avenue corridor was discussed in 3.3.3 and continues into Zone 3. Just as in Zone 1, ditches border both sides of Shadeland Avenue. There is also a large ditch network near Interstate 465. Most of Zone 3's ditches are in these two areas. The ditches along 465 are experiencing more erosion than those along Shadeland Avenue. In Zone 3, Shadeland Avenue is dominated by Eastgate Shopping Center, a nearly continuous 30 square block impervious surface stretching from 10th Street to the intersection of Washington St and Shadeland Avenue. Much of the central and southern half of the shopping center is unused commercial space and parking. The east side drains to a series of ditches (not part of the GIS) that form a tributary which eventually meets Pleasant Run at Pleasant Run Golf Course. The golf course's stream banks are scheduled to be restored in 2011/2012. From the golf course, Pleasant Run enters the CSO area and begins flowing through a large residential area that includes Ellenberger and Christian Parks and the Indy Parks Greenways. Once past Christian Park, the stream enters a more commercial/industrial area, dominated by the Citizen's Gas Coke Plant and the Hawthorn CSX Rail Yard—both of which were public concerns.

The Hawthorn CSX Rail Yard is a vast area from Arlington Avenue to Sherman Road that houses rail cars between trips. The yard is primarily unpaved dirt, and a member of the public was concerned about old spills, PCBs, and other legacy pollutants that may have contaminated the soil over the years. Friends of Pleasant Run contacted CSX about this concern, but no information was shared. Much of the rail yard is surrounded by a buffer of trees, although some of this buffer could be improved to maximize its ability to keep soil onsite.

Plate 31: Hawthorn CSX Rail Yard



Immediately west of the Hawthorn CSX Rail Yard is the Citizens Gas Coke Plant, which was also listed as a public concern. Friends of Pleasant Run worked with IDEM to learn about the Coke Plant. The following is from an email dated September 8, 2010.

The 87-acre Citizen's Gas Prospect Street facility operated as a coke and manufactured gas plant from 1908 until July 2007. As a result of the nearly 100-years of industrial activity at the site, impacts to soil and groundwater are fairly widespread across the site, although laboratory analytical data from soil and groundwater samples collected to date at locations around the perimeter of the property do not indicate that these impacts have migrated laterally beyond the property boundaries. Soil and *groundwater samples are analyzed for Volatile Organic Compounds (VOC), Semi-Volatile Organic Compounds (SVOC), Polychlorinated Biphenyls (PCB), metals, and other inorganic constituents. Although data collected to date does not indicate the migration of soil or groundwater contamination beyond the property boundaries surrounding the perimeter of the site, the site is likely contributing to off-site downstream contaminant migration into Pleasant Run Creek (given the high level of contamination located in the interior of the site). Although Pleasant Run is classified as an "impaired" waterway, it is understood that the historic operations at the Citizen's Gas facility are likely to have significantly contributed to the degradation of sediments in the creek. Because other sources of past industrial activity in this area and combined sewer overflows (CSOs) are also responsible for impacts to the creek, any remediation of the creek is something that would be most effective as part of a more comprehensive plan involving upstream CSOs, the industries discharging into them, and the constituents and levels they would anticipate. Remediation is not yet being conducted. Site investigations, and the demolition of previous site structures so that investigations can be conducted in the interior of the site, are being conducted in a phased approach in order to most efficiently facilitate site remediation as well as redevelopment at the site.*

As part of the Voluntary Remediation Program (VRP) cleanup (of which remediation of this site is being conducted under) for this site, discussions to facilitate any future improvements to Pleasant Run Creek will be coordinated between IDEM, the City of Indianapolis, and Citizen's Energy. Investigations and remediation will be conducted in a phased approach, with the ultimate site "closure" planned for several years down the road. Citizen's is required to submit a Remediation Work Plan, which must be approved by IDEM (and placed on public comment). [24]

Redevelopment of the site can't occur until IDEM approves the site's cleanup. Citizen's, however, already released a Proposed Reuse Vision for the Coke Plant on April 20, 2009. It has three broad objectives:

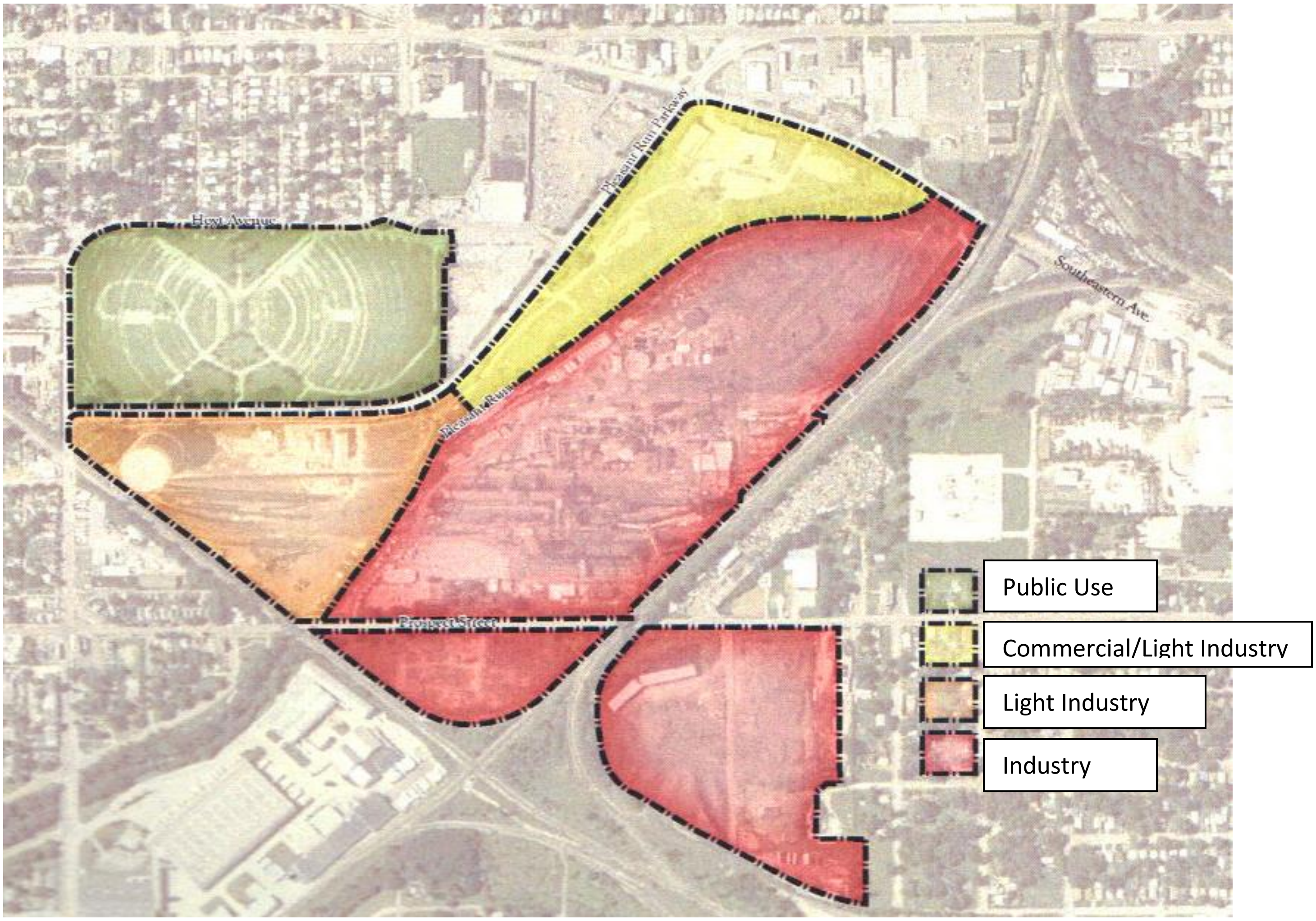
- A mix of attractive green space, recreational and community-sensitive development near the most highly populated portion of the surrounding residential area.
- Commercial or light industrial development along Pleasant Run Parkway west of Pleasant Run Creek.
- Heavier industrial development across the remainder of the Site to promote jobs and revitalization of the local economy.

The Reuse Plan divides the property into four distinct parcels:

- Main Plant: planned industrial use on majority with some light industrial/commercial use
- Twin Aire: planned public use (community accessible green space)
- South 40: planned industrial use
- Salvage Yard: planned industrial use[25]

[24] Email from Corey Webb, IDEM SEM
[25] Citizens Coke Plant Reuse Plan

Plate 32: Proposed Reuse of Coke Plant



Immediately downstream of the Coke Plant is the dam mentioned in the Watershed Inventory Part 1. Like Shirley Lake dam, DNR and DPW had no information about this structure, although it clearly impacts aquatic life movement. From the dam, Pleasant Run flows back into a residential area on the west side of Keystone Avenue. To the southeast of this area are Bethel Park and the missing tributary discussed in the Watershed Inventory Part 1. That tributary's headwaters include an abandoned rail yard and other unpaved areas near the intersection of Terrace Avenue and Sherman Dr. This area's soils are Highly Erodible and a wide buffer of trees or grass doesn't exist to keep the dirt onsite.

Plate 33: Large Unpaved Area Near Missing Tributary

To the north of where the missing tributary meets Pleasant Run sits a neighborhood that's part of the Southeastern Neighborhood Organization's (SEND) service area and has the potential for several storm water infiltration projects according to the Indianapolis Green Infrastructure Master Plan.

- Rain gardens where Saint Paul, Saint Peter, Harlan, and Churchman meet Pleasant Run Parkway

- A triangle park with rain garden at Orange and Reid

The Indianapolis GI Master Plan also calls for storm water infiltration along Beecher Street between East Street and Pleasant Run.

As Pleasant Run crosses Interstate 65 and approaches Garfield Park, the landuse becomes a mix of commercial and residential. Bean Creek meets Pleasant Run in Garfield Park.

Plate 34: Bean Creek empties into Pleasant Run

Upstream of this junction, Bean Creek's banks are stabilized by concrete blocks and within the CSO section, which is not within the park, both banks are concrete walls for a short distance. This area overlaps with the Concord Community Development Corporation's service area. The Indianapolis GI Master Plan lists Concord CDC as an area worthy of green infrastructure investment. Unfortunately, the plan does not outline any specific projects and only a small part of Pleasant Run Watershed—the area south of Raymond Street and west of Interstate 65—lies within the Concord CDC.

Once Pleasant Run exits Garfield Park, it flows past Holy Cross/Saint Joseph Cemetery, another residential area, and finally enters the White River. The mouth of the watershed and the area south of it is commercial and lightly industrialized. A gravel mine near the mouth has pits only a few feet from Pleasant Run. Dumping occurs where Pleasant Run crosses Bluff Road.

Plate 35: Pleasant Run meets White River

Zone 3 has a more mixed landuse than the other two zones, but the predominant landuse along Pleasant Run and Bean Creek is city owned park property. Ellenberger, Christian, and Garfield Parks, and the Pleasant Run Greenway all border streams. The park system, Keep Indianapolis Beautiful, and other stakeholders have done a good job protecting and enhancing the stream buffers. But as Map 15 shows, there are also areas in Zone 3 where buffers could be improved:

- Between Edmondson and Shadeland, just south of 16th Street
- Between Shortridge and Shadeland, just south of 16th Street

- Between Mitchner and Shortridge
- Between E. Pleasant Run Parkway and Edmondson, just north of 10th Street
- Between Shadeland and Shortridge in the Eastgate Shopping Center
- Portions of Pleasant Run Golf Course
- Portions of Ellenberger Park
- Near Street Paul and Street Peter Streets
- Between Laurel and Leonard Streets
- Portions of Garfield Park
- Between 31 and 135

Potentially Highly Erodible Soil covers the majority of Zone 3, but Highly Erodible Soil does cover the three sites with the greatest amount of open soil, the Hawthorn CSX Rail Yard, the Coke Plant, and the parcel along Sherman near Pleasant Run's missing tributary. The stream banks in Zone 3 are not classified as erodible, but most of the banks are armored with concrete blocks.

Zone 3 has four STEP neighborhoods. While most of the Zone's soils are unrated for septic suitability, these neighborhoods would not be scheduled for sewers if the city didn't believe their septic systems were failing. Once these four STEP projects are completed, a significant source of E. coli and TKN will be removed.

Zone 3 has hydric and partially hydric soils—mostly in the northern part of the zone— but these soils do overlap with some open space, creating opportunities to store and cleanse storm water naturally:

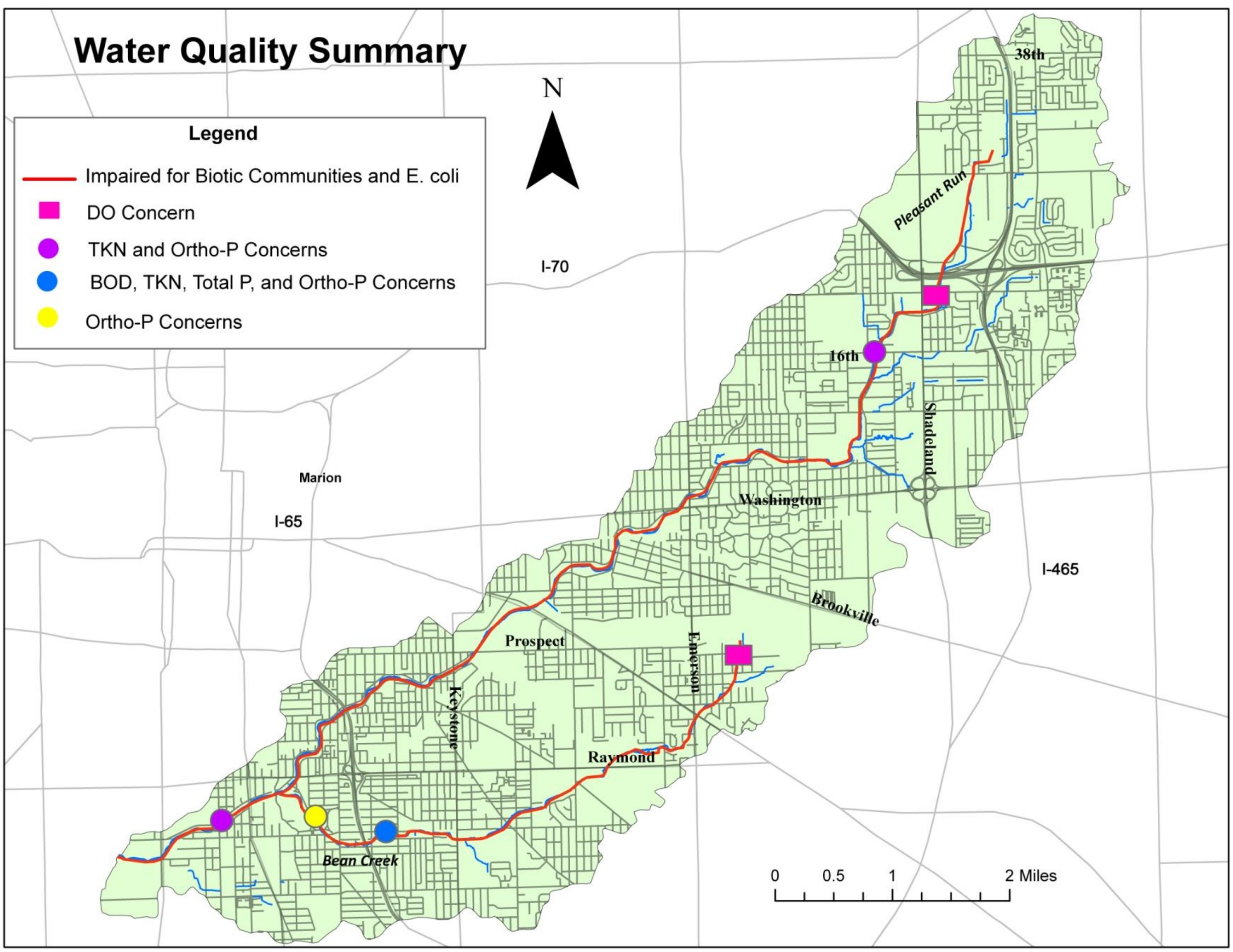
- Between 135 and Pennsylvania, south of Troy
- Site 2 from Appendix C, near the mining pit at the watershed's mouth
- Site 2 from Appendix C, east of Bluff Road and South of Gimber Court are existing natural wetlands (existing wetlands should be preserved and can't be used to cleanse storm water)
- West of E. Yoke Street (Named Columbia Park on Google Maps, but not part of Indy Park's database)
- Pleasant Run Greenway, along Avon Avenue
- Between Springbrook N. Dr. and Springbrook S. Dr., east of Edmondson
- Portions of Pleasant Run Golf Course
- Along Pleasant Run between 10th and 16th Streets
- Pleasant Run Greenway, between Michigan and Washington
- Pleasant Run Greenway downstream of Christian Park

3.6 Watershed Inventory Summary

IDEM has listed Pleasant Run's entire stretch and Bean Creek downstream of Orange Street as impaired for E. coli. Very little variation in any of the data exists between sites—even when comparing the areas with and without CSOs. Along Pleasant Run, TKN consistently exceeded its benchmark at 16th Street and Meridian Street. At every DPW sampling point, Ortho-P's median concentration exceeded the benchmark; its highest exceedance was along Bean Creek in Garfield Park. Bean Creek's and Pleasant Run's DO scores during the summer months increased with distance from the headwaters, suggesting that restoration in both headwaters may benefit DO levels. Many parameters (Total P, BOD, and TKN) showed increases in Bean Creek at Southern Avenue during wet weather. While these increases did not exceed any benchmarks, they do highlight the influence of storm water.

IDEM has listed Pleasant Run's entire stretch and Bean Creek downstream of Orange Street as impaired for Biotic Communities. Scores along Bean Creek were either 'Fair' or 'Fairly Poor'. Pleasant Run had a wider variety of scores. The most upstream site, at 21st Street scored 'Poor' to 'Very Poor' while further downstream scores ranged from 'Fair' to 'Good'. The CSOs did not appear to influence macroinvertebrate scores. For both Pleasant Run and Bean Creek, work to improve the macroinvertebrate scores should begin in the headwaters.

Map 22: Water Quality Summary



Decisions

&

Goals

4.1 Analysis of Stakeholder Concerns

Using the data from the Watershed Inventory, the list of public concerns was revisited to decide which ones fit within the group's scope and which concerns should be a focus. Not every concern chosen as a focus can receive immediate attention.

Figure 21: Analysis of Concerns

Concern	Supported by Our Data?	Quantifiable?	Outside Scope of Our Group?	Group Wants to Focus on?
Effect of golf course chemicals on water quality	No, and golf course staff were never able to be set up.	Yes	No	Yes, as part of general education
Citizens Gas property: legacy pollutants, runoff to Pleasant Run, question of whether groundwater seepage is still being treated	Yes, IDEM confirmed legacy pollution. Groundwater not being treated.	Yes, IDEM has data.	Yes	No, IDEM is in charge of cleanup
Hawthorn Rail yards: legacy pollutants	Inconclusive, information on legacy pollutants not available. Opportunities to plant trees may exist.	No	Yes	No, where pollutants do exist state or city would lead cleanup
Lack of wildlife along stream corridor and in stream	Yes, Marion County has many threatened and endangered species. Biotic communities within the stream are impaired according to the State.	Yes	No	Yes
Runoff at Foundry (Sherman Avenue and Washington Street)	No, not within watershed.	No	Yes	No, not within watershed
Reducing runoff from new construction	Yes, SWCD says additional oversight is needed.	Yes, storm water control plans for construction sites are public knowledge	No	No, SWCD is in charge of oversight
Overall need to reduce storm water runoff	Yes, CSOs, bank erosion, and some water quality scores are all influenced by storm water.	Yes, water quality data shows storm water influence.	No	Yes

Concern	Supported by Our Data?	Quantifiable?	Outside Scope of Our Group?	Group Wants to Focus on?
Runoff at Harvester Parking lot on Brookville Road	Yes, there is a large lot generating runoff.	No, measuring lot runoff during this study was cost prohibitive	Yes	No, Irvington Development Organization is working with Harvester
Invasives in Garfield Park came back quickly after removal	Inconclusive, conflicting information from different sources	No	No	Yes
Questions about the necessity and impact of dams at Shadeland Ave and at Prospect Street	Inconclusive, no agency has information about the dams. Their necessity is unknown.	No	No	Yes, we want more information
Crime in riparian area near Shelby Street and Keystone Avenue	Inconclusive, no resources to determine if this area had greater crime than other areas.	No	Yes	No, Metropolitan Police have jurisdiction
Invasive plants throughout the watershed	Yes, KIB and The Nature Conservancy agree in their pervasiveness.	No, quantifying invasives during this study was too cost prohibitive.	No	Yes
Algae and foam in stream at 10th Street and Arlington Avenue	Not observed in any surveys to date.	No	No	No, lack of data makes focusing on this concern difficult
Combined Sewer Overflows	Yes, locations shared by DPW.	Yes	Yes	Yes, CSOs should be mentioned in our education efforts
The need for more downspout disconnects to reduce residential	Yes, CSOs, bank erosion, and some water quality scores are	Yes, water quality data shows storm	No	Yes

runoff	all influenced by storm water.	water influence.		
Concern	**Supported by Our Data?**	**Quantifiable?**	**Outside Scope of Our Group?**	**Group Wants to Focus on?**
Illegal dumping (solids, oil, leaves) in the watershed and in storm sewers	Dumping identified in two spots. Pouring items down storm sewers is likely a problem throughout the area.	No	No	Yes
Recreational safety (E. Coli impairment): where do kids play in stream?	Yes, streams are impaired for E. coli and locations of stream access mapped.	Yes, both E. coli scores and public access points to streams.	Yes	Yes, recreational safety should be mentioned in our education efforts
Lack of education about local water quality	Inconclusive, there is education, but it may not be reaching the widest audience.	No, measuring education's impact during this study was cost prohibitive.	No	Yes
People need to know how to improve water quality through actions they can take at home	Yes, this was a comment at every project meeting.	No, measuring people's needs during this study was cost prohibitive.	No	Yes
Need for water conservation for drinking water purposes	No, water restrictions are not in place. The watershed is not a drinking water source.	Yes, there have been no restrictions.	Yes	No, the watershed is not a drinking water source
Log jams behind bridges	No, none found during windshield survey.	No	Yes	Yes, ways to reduce log jams should be mentioned in our education efforts

Pooling behind log jams invites mosquitoes	No, logs jams not found.	No	Yes	No
Concern	**Supported by Our Data?**	**Quantifiable?**	**Outside Scope of Our Group?**	**Group Wants to Focus on?**
General debris in stream (need for cleanup)	Yes, Friends of Pleasant Run did a stream cleanup. SEND does an annual cleanup.	Yes, but not done as part of this study.	No	Yes
Can the public buy zero phosphorus lawn fertilizer?	Yes, zero phosphorus fertilizer is available.	Yes, a list of stores is in the WMP.	No	Yes
Are septic systems located in the watershed?	Yes, map of areas to be sewered is in the WMP.	No, actual number of septics was not found.	No	Yes, septics should be mentioned in our education efforts
Landowners need to know what to do with standing water (besides channeling it away)	Yes, this was a comment at every project meeting.	No, Friends of Pleasant Run asked DPW for list of standing water complaints, but never received the information.	No	Yes
Bank erosion in watershed (i.e. at Keystone and Pleasant Run)	Yes, surveys found erosion and mapped it.	Yes	No	Yes
Lack of buffer along steam banks	Yes, all stream buffers were mapped.	Yes	No	Yes
Roadside ditches are eroding	Yes, windshield survey found examples of eroding ditches.	No, a map of every eroding ditch was not made.	No	Yes
Are there regulated drains in Marion County? Who is in charge of ditch maintenance?	Yes, there are drains, but they are not maintained.	Yes, DPW shared a map of drains.	No	No, city is in charge
Bean Creek is buried near Harvester site? (possible daylighting project)	Yes, it is buried.	Nothing to quantify.	No	Yes

Salt from Interstate 465 and 70 interchange	No	No	Yes	No
Concern	**Supported by Our Data?**	**Quantifiable?**	**Outside Scope of Our Group?**	**Group Wants to Focus on?**
Do any of the schools in the watershed do Hoosier Riverwatch?	No	No	No	Yes, Hoosier Riverwatch should be mentioned in our education efforts
Are there State Impaired sections of the streams	Yes, IBC and E. coli impairments exist.	Yes, they are mapped.	No	Yes
Additional water testing in certain neighborhoods may be needed	Yes, wet weather samples are needed.	Nothing to quantify.	No	Yes
Number of storm water ponds and their impact on water quality	Yes, there are ponds. Data doesn't support or deny possible impacts	Yes, DPW shared a map of ponds. Their impact is not quantifiable	No	Yes

5.1: Identify Problems, Causes, and Sources

Problems are conditions that exist because of the concerns. The identification of problems is an important step towards setting project goals and was done by grouping similar concerns together and creating a problem statement that encompassed those concerns. Some concerns fit in more than one group, but that does not mean they are more important than other concerns. Concerns originally posed as questions have now been changed to statements. This was done because data collection resolved ambiguity about those concerns.

A Cause is an event, agent, or series of actions that produces a problem. Causes may include pollutants, social behaviors, etc. Some problems and causes might be identical. IDEM requires that potential causes of water quality problems be defined as a specific pollutant parameter, but secondary causes may also be identified.

A Source is an activity, material, or structure that results in a cause of runoff pollution. Sources should be described in enough detail to show the part of the watershed where they occur and, when applicable, what their magnitude is across the watershed. Sources were identified in the Watershed Inventory Parts One and Two. The figure below summarizes those findings, matching Problems and Causes with their corresponding Sources. IDEM does not require Sources for social problems like education.

Figure 22: Concerns, Problems, Potential Causes, and Potential Sources

Concerns	Problem	Potential Cause(s)	Potential Source(s)
- State Impaired sections of the streams - Bean Creek is buried near Harvester site (possible daylighting project) - Roadside ditches are eroding - Lack of buffer along steam banks - Bank erosion in watershed - General debris in stream (need for cleanup) - Invasive plants throughout the watershed - Lack of wildlife along stream corridor and in stream	Stream/ditch banks and riparian zones need restoration	Invasive species are widespread	-Invasives are prevalent throughout. Prominent sources include stream corridors and residential property.
		Storm water runoff scours the stream channels, causing erosion and bank instability	-Headwaters of Pleasant Run and Bean Creek have large areas of impervious surfaces. I.E. Shadeland Avenue, Harvester Plant, Ford Complex and surrounding properties. -Residential properties: gutters directly connected to storm sewers and infiltration opportunities not recognized/utilized. -Infiltration ability of storm water ponds and ditches could be improved. Both are predominantly in the headwaters.
		IDEM lists biotic communities as impaired	- Poor buffers: 7.35 miles of grass buffers and 6.8 miles of shrub/bush buffers (see Map 15 for exact locations). -Storm water (see sources in row above) -Nutrient pollution (possible source of low DO) from septic systems. Septic areas identified by the STEP project (15 areas across watershed) are on Map 13. -Hydromodification of the watershed: two dams, network of ditches in headwaters, buried stream at Harvester Plant
		Stream buffers need improvement	-Poor buffers: 7.35 miles of grass buffers and 6.8 miles of shrub/bush buffers. See Map 15.

Concerns	Problem	Potential Cause(s)	Potential Source(s)
- Additional water testing in certain neighborhoods may be needed - No schools in the watershed do Hoosier Riverwatch - Landowners need to know what to do with standing water (besides channeling it away) - Septic systems in the watershed - Log jams behind bridges - People need to know how to improve water quality through actions they can take at home - Lack of education about local water quality - Recreational safety (E. Coli impairment): kids playing in stream - Illegal dumping (solids, oil, leaves) in the watershed and in storm sewers - Combined Sewer Overflows - Increase public access and use of zero phosphorus lawn fertilizer	Public lacks education about how their actions impact Pleasant Run Watershed and what they can do to improve watershed health	-Limited resources for public education -Education is not spread across different media	N/A

Concerns	Problem	Potential Cause(s)	Potential Source(s)
- Roadside ditches are eroding - Landowners need to know what to do with standing water (besides channeling it away) - The need for more downspout disconnects to reduce residential runoff -Combined Sewer Overflows - Overall need to reduce storm water runoff	There is too much storm water runoff in Pleasant Run Watershed	Impervious surfaces	-Headwaters of Pleasant Run and Bean Creek have large areas of impervious surfaces. I.E. Shadeland Avenue, Harvester Plant, Ford Complex and surrounding properties. -Residential property throughout the watershed.
		Downspouts connected to storm drains	-Prevalent throughout the watershed
		Storm water infiltration not strongly encouraged	Infiltration could be increased by focusing on the following sources: -Poor buffers: 7.35 miles of grass buffers and 6.8 miles of shrub/bush buffers (Map 15) -Residential properties. - Storm water ponds and ditches could be improved. Both are predominantly in the headwaters.

Concerns	Problem	Potential Cause(s)	Potential Source(s)
- Number of storm water ponds and their impact on water quality - State Impaired sections of the streams - Lack of buffer along steam banks -Septic systems in the watershed - Recreational safety (E. Coli impairment): kids playing in stream - Combined Sewer Overflows	E. coli levels exceed the State Water Quality Standard	E. coli levels exceed the State Water Quality Standard	-55 CSOs (Map 11) -Septics (Map 13) -Storm water ponds, which are predominantly in the headwaters. -Pet waste from residential property: Bean Creek has more residential property along its banks than Pleasant Run. -Pet waste from park property -Inadequate stream buffer(Map 15).
- Number of storm water ponds and their impact on water quality - Lack of buffer along steam banks - Septic systems in the watershed - Increase public access and use of zero phosphorus lawn fertilizer - Combined Sewer Overflows - Effect of golf course chemicals on water quality - Roadside ditches are eroding - Bank erosion in watershed - Invasive plants throughout the watershed	Parts of Pleasant Run Watershed have nutrient levels exceeding the target set by this project	TKN and Ortho-P levels exceed the target set by this project	-55 CSOs (Map 11) -Septics (Map 13) -Storm water ponds, which are predominantly in the headwaters. -Pet waste from residential property: Bean Creek has more residential property along its banks than Pleasant Run. -Pet waste from park property -Fertilizer from residential property: Bean Creek has more residential property along its banks than Pleasant Run. -Fertilizer from the two golf courses. -Soil erosion from banks, ditches, areas overtaken by invasive species, and construction sites

6.1: Loads for each Pollutant Identified as a Problem's Cause

A pollutant load is a measure of the amount of pollutant in the stream during a period of time. Examples include, pounds/week and tons/year. IDEM requires current loads for each pollution parameter Friends of Pleasant Run listed as a problem's cause (E. coli, TKN, and Ortho-P). Target loads meeting the applicable water quality standard or benchmark are also required. As described below, different methods were used to generate the loads for each parameter.

In order to calculate a load, one needs a measurement of stream flow (the amount of water in the stream) and the concentration of a pollutant from the stream. Milligrams per liter (mg/L) is an example of a concentration. The load is the product of flow (usually in cubic feet of water per second) and pollutant concentration and represents pollution from both point (factories, CSOs, septics, etc.) and nonpoint (runoff) sources. Separating point and nonpoint loads is difficult. One method involves modeling the combined point and nonpoint loads, modeling the nonpoint loads, and subtracting the differences. This method only works if both models can calculate loads for the pollution parameters you're interested in.

Loads for the Pleasant Run Watershed were calculated in several ways. The E. coli load was taken from the TMDL. LOAD ESTimator (LOADEST) was used by a volunteer with professional experience running models and calculating loads for watershed groups. LOADEST is a computer model for estimating pollutant loads in streams. Given a time series of streamflow, additional data variables, and pollutant concentration, LOADEST develops a regression model used to estimate loads over a user-specified time interval.[26] The pollutant loads from LOADEST are estimated based on real data from two sources.

1. Stream flow data from the United States Geological Survey stream gage on Pleasant Run at Arlington Ave.

   - Because of its location on Arlington Ave., the gage only measures flow for 30% of the watershed. Based on conversations with IDEM, it was decided to estimate the entire watershed's flow using the flow at the gage station and adding 70% (based on the percentage of the drainage area downstream of the gage).

2. DPW data from the sampling station at Pleasant Run and Meridian St.

   - Meridian St. sampling station is after the confluence of Pleasant Run and Bean Creek and is the last sampling station before the watershed ends at the White River. DPW data represents point and nonpoint sources.

TKN and Ortho-P loads current and target loads were estimated by LOADEST. Current loads were based on streamflow and water quality data. Target loads were based on streamflow and water quality targets for the pollution parameters. After running LOADEST, it was felt that the Ortho-P load was overestimated. This problem goes back to the intermittent Ortho-P sampling DPW has done. Of the 75 samples, only 24 of them were above the detection limit for the method used. The steering committee was uncomfortable estimating loads based on such a small sample set. However the committee did feel that based on the Ortho-P data they did have, along with information about landuse and potential sources, there was sufficient evidence to suspect phosphorus as a pollutant in Pleasant Run Watershed. Instead of a load for Ortho-P, a load of Total Phosphorus (which includes Ortho-P) was estimated using LOADEST. DPW's Total Phosphorus data was never above its benchmark, however LOADEST suggests a large reduction is needed (Figure 20). This difference may be attributed to the lack of reliable wet weather data. As discussed above, Friends of Pleasant Run could not be 100% certain which DPW sampling events were wet weather. LOADEST, by integrating continuous monitoring from a stream gage into its calculations, takes weather into account.

LOADEST's Total Phosphorus estimate includes nonpoint and point sources. Since a main purpose of this watershed plan is to focus on reducing runoff pollution, Friends of Pleasant Run needed a way to separate the point and nonpoint pollution. Using

[26] http://water.usgs.gov/software/loadest/

the Spreadsheet Tool for Estimating Pollutant Load (STEPL), we estimated the nonpoint Total Phosphorus pollution. STEPL cannot estimate TKN loads, so we are unable to differentiate between its point and nonpoint loads.

Figure 23: Point + Nonpoint Pollutant Loads from LOADEST Model

Pollutant	Current Load	Target Load	Reduction Needed
TKN	128,316 lbs/year	56,254 lbs/year	72,062 lbs/year (56%)
Total Phosphorus	36,701 lbs/year	7,234 lbs/year	29,468 lbs/year (80%)
E. coli	3.06×10^{11} cfu during recreational season upstream of the CSO area 5.23×10^{13} during recreational season within the CSO area	2.57×10^{10} cfu	92% upstream of the CSO area and 99.9% within the CSO area

Figure 24: Total Phosphorus Nonpoint Load From STEPL

Current Load	Target Load	Reduction Needed
15,057 lbs/year	2,975 lbs/year	12,082 lbs/year (80%)

7.1: Goals and Indicators

Using the defined Problems as a starting point, the steering committee discussed the large-scale changes they'd like to see in the watershed. That discussion eventually led to six goals designed to improve and protect the water quality in Pleasant Run Watershed. Modeling of pollution removal rates from BMPs suggests that attaining these goals strictly by installing BMPs will be difficult. Encouraging the public to change their behavior and keep pollution from running off must be a priority. See 8.1 for more information on achieving the goals.

Each goal also includes an indicator. Indicators are measures that determine whether progress towards a goal is being made. Indicators can be administrative in nature (number of meetings held) or environmental (reduced pollutant loading).

Goal 1: Promote and support public participation of efforts that will improve the wildlife habitat and water quality of the Pleasant Run Watershed. *Indicators will be the number and type of public participation events and opportunities as well as progress towards achieving goals 2-6.*

Goal 2: Within 5 years, improve instream habitat so Benthic Macroinvertebrate scores at MCHD sampling sites go up one assessment level from current levels. *The indicator will be Benthic Macroinvertebrate scores taken at MCHD's existing sites in the watershed.*

Goal 3: IDEM says the recreational season E. coli bacteria load upstream and within the CSO area is 3.06×10^{11} cfu and 5.23×10^{13} respectively. Those loads must be reduced 92% and 99.9% in order to meet the E. coli water quality standard of 125 cfu/100 ml. Our goal is for the entire watershed to meet that standard within 25 years. *The indicator will be monthly sampling done by DPW and MCHD at their existing sites in the watershed.*

Goal 4: The annual load of TKN is 128,316 lbs. Within 10 years we want to reduce it to the target load of 56,254 lbs/year. *The indicator will be monthly sampling done by DPW at their existing sites in the watershed.*

Goal 5: The annual nonpoint load of Total Phosphorus is 12,082 lbs. Within 10 years we want to reduce it by 30% to 8,457 lbs/year. *The indicator will be STEPL modeling that factors Total Phosphorus reductions from installed BMPs.*

Goal 6: Once completed, Indianapolis' Long Term Control Plan will capture 207 million gallons of CSO annually from the Pleasant Run Watershed. Our goal is, within 10 years, to infiltrate 3% of that amount into the ground. *The indicator will be the sum of the storm water infiltrated from the practices installed as part or in support of this project.*

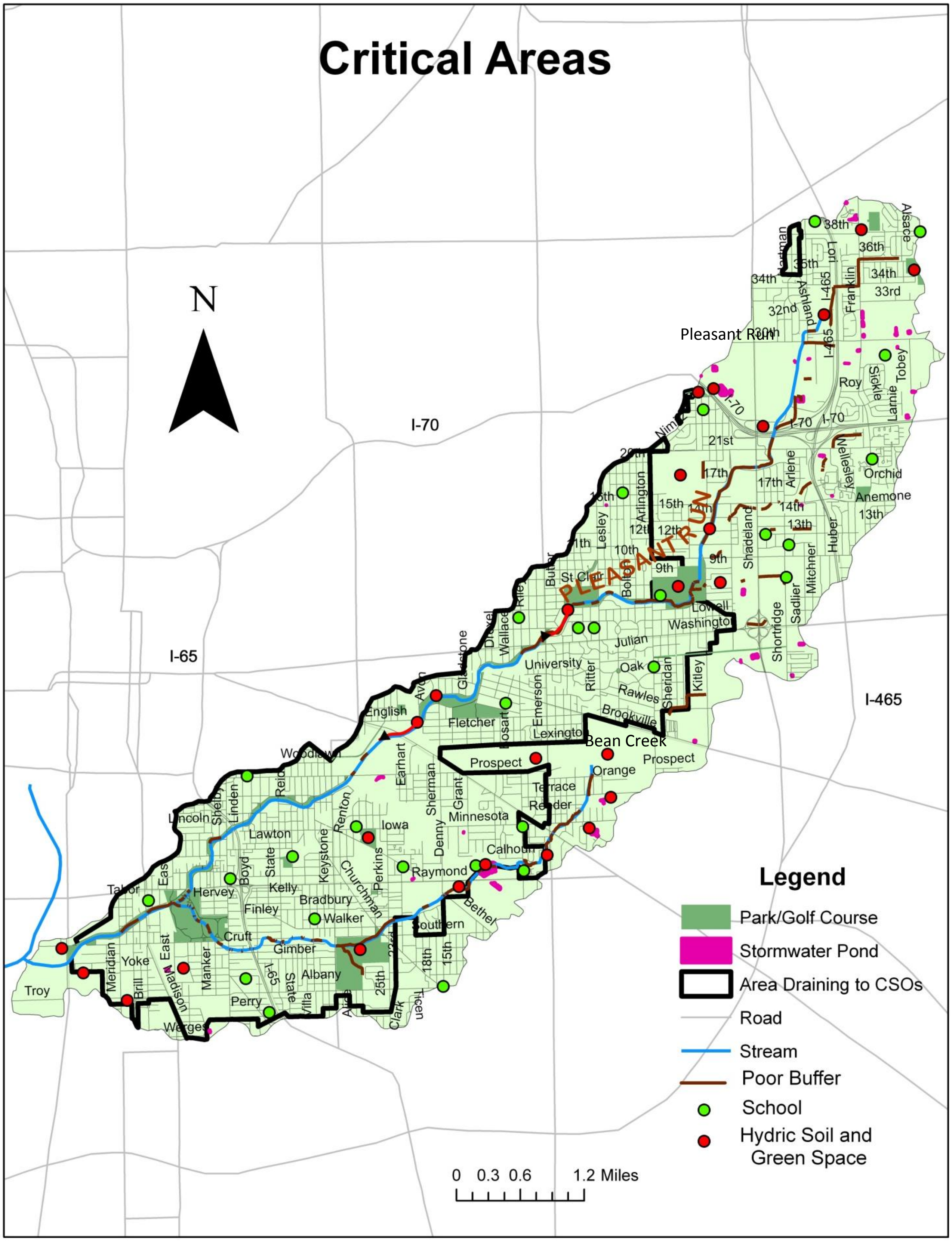
7.2: Critical Areas and BMPs/Measures

Critical Areas are defined areas where implementation of this watershed plan can reduce runoff sources in order to improve water quality and/or mitigate the impact of future sources in order to protect water quality. Critical Areas are defined as a way to better direct resources to where they might best impact the Pleasant Run Watershed. Five Critical Areas where chosen.

- Poorly buffered streams and tributaries
- Residential areas, schools, parks and golf courses, and churches (these offer opportunities to reduce fertilizer use, E. coli, nutrients, and storm water)
- Storm water ponds
- Green space overlapping with hydric soils
- Areas upstream of the CSOs

Map 23 shows these areas, with three exceptions. Residential areas and churches are not mapped and the CSO shapefile shows the areas downstream of the CSOs. We want to focus on areas upstream of the CSOs.

Map 23: Critical Areas



In Figure 22, proposed Best Management Practices (BMPs) chosen by the steering committee are matched up with the appropriate Critical Area. Using the Region V Model and STEPL, an estimate of the number of BMPs needed to meet the goals were calculated. The Region V Model and STEPL are both pollutant loading models recommended by IDEM and USEPA. Since neither model estimates E. coli or TKN for the BMPs chosen by the steering committee, only estimates of the number of practices needed to reach Goals 5 and 6 are possible. The amount of BMPs needed to reach the Total Phosphorus goal is tremendous, which is why the steering committee has put a emphasis on education and outreach. Appendix H defines certain BMPs.

Figure 25: Critical Areas, BMPs/Measures, and Load Reductions

Best Management Practice	Number Needed to reach a Goal(s)	Critical Area(s)	Reason Area is Critical
Plant Trees	2,610[1] trees absorbing 2,380 gallons of storm water a year will achieve Goal 6	Poorly buffered streams and tributaries	Habitat and reducing storm water, nutrients and E. coli
		Residential areas, schools, parks and golf courses, and churches	Storm water reduction/infiltration and reducing fertilizer use
		Storm water ponds	Reducing E. coli, nutrients, and storm water
		Green space overlapping with hydric soils	Protect and/or restore wetland functions
No Mow Zones (AKA: Vegetative Filter Strip)	No Mow Zones covering 3,625 acres, or 25% of the watershed[2] will reduce 1 lb of Total Phosphorus/acre/yr and achieve Goal 5	Non CSO Area	E. coli and improving instream habitat
		Poorly buffered streams and tributaries	Habitat and reducing storm water, nutrients and E. coli
		Storm water ponds	Reducing E. coli, nutrients, and storm water
		Green space overlapping with hydric soils	Protect and/or restore wetland functions
Add terracing (2-stage ditch design)	Too many variables to estimate	Non CSO Area	E. coli and improving instream habitat
Buffers of wildlife friendly native species	Buffers covering 3,625 acres, or 25% of the watershed[2] will reduce 1 lb of Total Phosphorus/acre/yr and achieve Goal 5	Residential areas, schools, parks and golf courses, and churches	Storm water reduction/infiltration and reducing fertilizer use
		Storm water ponds	Reducing E. coli, nutrients, and storm water
		Green space overlapping with hydric soils	Protect and/or restore wetland functions
		Non CSO Area	E. coli and improving instream habitat

Best Management Practice	Number Needed to reach a Goal(s)	Critical Area(s)	Reason Area is Critical
Rain barrels/cisterns	10,350 50 Gallon Rain Barrels or 516 1000 Gallon Cisterns filling up 12 times a year achieves Goal 6[3]	Residential areas, schools, parks and golf courses, and churches	Storm water reduction/infiltration and reducing fertilizer use
Rain garden, bioretention cell, or other infiltration device	5,699 acres[4] filtering 0.63 lbs/acre/yr of Total Phosphorus achieves Goal 5. 1,166 rain gardens[5] absorbing 444 gallons 12 times/yr achieves Goal 6.		
Vegetative swales/ditches	614 swales/ditches filtering 6 lbs Total Phosphorus/practice/yr achieves Goal 5		
Downspout disconnects	1,152 disconnects[6] achieves Goal 6		
Retrofit storm water pond (AKA Extended Wet Detention)	Goal 5 achieved by modifying ponds collecting runoff from 906 acres. Assume 4lb/yr Total Phosphorus filtered from each acre.	Storm water ponds	Reducing E. coli, nutrients, and storm water
Wetland plantings/restorations	Too many variables to estimate	Green space overlapping with hydric soils	Protect and/or restore wetland functions
		Storm water ponds	Reducing E. coli, nutrients, and storm water
Pervious pavers, concrete, etc	Pervious surface covering 3,625 acres, or 25% of the watershed will reduce 1 lb of Total Phosphorus/acre/yr and achieve Goal 5	Residential areas, schools, parks and golf courses, and churches	Storm water reduction/infiltration and reducing fertilizer use
Green Roof	Too many variables to estimate		
Install 'Pick up after Dog' signage, trash bags, and cans	Too many variables to estimate	Non CSO Area	E. coli and improving instream habitat
		Residential areas, schools, parks and golf courses, and churches	Storm water reduction/infiltration and reducing fertilizer use
Remove Bean Creek from underneath Harvester parking lot	Too many variables to estimate	Non CSO Area	E. coli and improving instream habitat
Remove the watershed's dams	Too many variables to estimate		
Add micro habitat locations to the stream channel	Too many variables to estimate		

1. Based on a medium sized tree intercepting 2,380 gallons of rainfall a year. From: the Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California. July 2002.
2. Estimated with the Region V Model. Estimates assume 1 acre draining into the BMP. Size of BMP is not part of the model.
3. Based on a 50 gallon rain barrel and 1000 gallon cistern filling up 12 times a year.
4. Estimated with STEPL.
5. Based on a 60 cubic foot rain garden filling up 12 times a year.
6. Based on 300 ft^2 feeding one downspout and 900 ft^3 flowing down the spout each year. Plate 2 estimates that 80% of that water will infiltrate or evapotranspired.

8.1 Action Register and Schedule

The Action Register is a figure displaying the goals' objectives. Objectives are specific strategies that the steering committee felt would help Friends of Pleasant Run achieve its goals. Where objectives are shared by multiple goals, it is noted. The steering committee prioritized the objectives into four groups by voting. Objectives within the same priority group and are listed without any preference. The Action Register also includes milestones, estimated financial costs, and possible partners and needed technical assistance. Milestones are steps that show the objective is being implemented on a schedule. Keeping track of milestones will help Friends of Pleasant Run stay on schedule and demonstrate progress. The schedule, outlined as part of the milestones, starts once Friends of Pleasant Run finds funding sources and is outlined for five years. After five years, progress on the watershed plan should be evaluated and the plan revised as necessary.

Figure 26: Pleasant Run Watershed Action Register

Priority 1: Each objective is scheduled to begin during the first year of implementation. Unforeseen realities may change that schedule.

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Workshops on building your own Rain Barrel or Rain Garden and Open Houses to see residential water quality BMPs	1, 5, & 6	The public and neighborhood groups	Within 6 months contact neighborhood groups and find a site for the open house	<$1,000	PP=Neighborhood groups TA=Someone to demonstrate the practices	Indianapolis Drum carries barrels suitable for rain barrel construction. www.indydrum.com
			Hold events by end of year 1	$5,000		
Add terracing (2-stage ditch design) to stream channel	2, 4, & 5	Landowners along the stream	During first 6 months, identify possible sites	$1,000-$5,000	PP=Landowners TA=Consulting firm	Possible project site at 16th Street and Edmondson
			By end of first year, have gauged interest of landowners	$1,000-$5,000		
			Begin design and construction after year 1	$26/linear foot		
Install BMPs that infiltrate storm water and/or filter runoff Examples include:	2, 5, & 6	The public	Within six months, set up a cost-share program and begin searching for projects	$1,000-5,000	PP=Landowners and Sustain Indy TA=Consulting firm, SWCD	Indianapolis Drum carries barrels suitable for rain barrel construction. www.indydrum.com
			Advertise the program to partners	<$1,000		
Rain Barrels				$100		
Rain Gardens				$2.90-$8.00 sq. ft(self installed)		
Bioretention				$8.00-$17.00/sq. ft.		
Ditch/swale plantings				$13.00 linear		

				ft.		
Green roof				$8.00-$20.00/sq. ft.		
Infiltration device				Too many variables		
Pervious pavements				$0.50-$10.00/sq. ft.		
Objective	**Goal(s)**	**Target Audience**	**Milestone**	**Cost**	**Possible Partner (PP) and needed Technical Assistance (TA)**	**Existing Resources**
Display information in hardware stores explaining where to find items that benefit the watershed. Examples include: Native Plants, Rain Barrels, Downspout Extenders, and Zero Phosphorus Fertilizer.	1	The public	Within 6 months contact hardware stores	$1,000-2,000	PP=Hardware Stores	
			Have displays in place by end of year 1			
Partner with schools on BMPs and lesson plans on the practice and other relevant topics. Encourage Hoosier Riverwatch monitoring.	1	Schools and children	Within 1 year, identify interested schools	$1,000-$5,000	PP=Schools	www.hoosierriverwatch.org Project Wet for curriculum ideas
			By end of year 2 complete details on BMP/lesson plans			
			Implement during year 3			
Increase residential awareness of household waste/nutrients entering streams via CSOs and dumping. Encourage use of Toxdrops.	1	The public	Within 6 months gather information about local tox drops	<$1,000	PP=City of Indianapolis	List of toxdrop locations at www.kib.org
			By end of year 1 encourage use of toxdrops through website and other media			

			During year 2 work with city to get 'No Dumping' marked on storm drains			
Objective	**Goal(s)**	**Target Audience**	**Milestone**	**Cost**	**Possible Partner (PP) and needed Technical Assistance (TA)**	**Existing Resources**
Plant trees along poorly buffered areas	2 &6	Landowners along the stream	In year 1, identify interested landowners and neighborhood groups	$5,000	PP=Landowners and KIB	www.kib.org
			Starting in year 2, help interested parties apply to KIB for trees	$1,000/group wanting help		
Backyard Habitat program for residential areas along the stream	2 &6	Residential landowners along the stream	Develop program during first 6 months	<$1,000	PP=Landowners and nurseries	Marion County SWCD, Indiana Wildlife Federation, Hoosier Heartland RC&D
			Advertise and begin implementation after 6 months	$800/backyard		

Priority 2: Each objective is scheduled to begin during the second year of implementation. Unforeseen realities may change that schedule.

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Retrofit storm water ponds into Extended Wet Detention BMP	3 &4	Storm water pond owners	In year 2, identify interested landowners	$1,000-5,000	PP=Landowners and mowing crews TA=Consulting firm	Hamilton County SWCD has experience promoting and implementing this type of practice
			In subsequent years, try to partner with two pond owners a year	$1.25/Sedge Meadow Plug planted 1 ft on center $5-20,000 to modify pond riser		
Include information on bacteria impairment, CSO Plan, and septics in 'Protect Pleasant Run' outreach	3 &4	The public	In year 2, gather existing resources on these topics	$1,000-$2,000	PP=Eastside Voice	DPW webpage, Marion County SWCD, IDEM Watershed Page
			In year 2 and onward, include Pleasant Run specific details in public education efforts	$1,000/yr		
Support STEP project by mapping septic systems	3 &4	DPW and the public	By end of year 2, have worked with MCHD and DPW to find data on septic locations	$1,000-$2,000	PP=DPW, MCHD TA=consultant or a volunteer with GIS mapping software	
			By end of year 3, have mapped all septics	<$1,000		

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Install 'Pick up after Dog' signage, trash bags, and cans	3 &4	The public	By end of year 2 have picked possible locations	<$1,000	PP=Indy Parks	
			In year 3 and 4 work with on installation	$5,000		
Include information about disconnecting downspouts in 'Protect Pleasant Run' outreach and find volunteers willing to do disconnects for homeowners	5 &6	The public	By end of year 2, include information in education efforts and solicit for volunteers	<$1,000	PP=Volunteers	
			In subsequent years, track number of disconnects and continue education	<$1,000		
Stream clean up days	1	The public	Hold at least one event a year	$1,000-2,000	Neighborhood groups, KIB, SEND, Indy Parks	
Post educational 'Protect Pleasant Run' information to the Facebook page	1	The public	One posting a week	<$1,000	N/A	Water savings tips at: www.indianapoliswater.com
Establish No Mow Zones along the stream	2	Non residential landowners along the stream	In year 2, identify interested landowners	$1,000-$5,000	PP=Landowners and mowing crews	
			Establish zones in year 3	$1,000-2,000		
Add natural material to the stream to increase habitat for macroinvertebrates	2	Landowners along the stream	By end of year 2, identify all permitting requirements	$1,000-5,000	PP=Landowners TA=IDEM, consulting firms	
			During year 3, locate projects and begin implementation	$5,000-$10,000		

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Encourage LID in areas of new or redevelopment	6	Landowners and developers	During year 2, work with city to become notified of building permit applications	$1,000-$2,000	PP=Development community, Sustain Indy TA=LID Expert to assist with outreach	Upper White River Watershed Alliance might share resources on LID. USEPA has information. Save the Dunes has done considerable outreach to developers on LID.
			By end of year 2, notify local developers and architects of interest in working with them on LID	$1,000-5,000		
			Work with parties as interest arises	Most likely >$5,000 per project		
Invasive species removal	1	The public	In year 2, begin developing needed partnerships to have a removal day	$1,000-$2,000	PP= Indy Parks, neighborhood groups, KIB, SEND	
			Hold 1 event a year after year 2	$1,000-$2,000		

Priority 3: Each objective is scheduled to occur during year 3-5 of implementation. Unforeseen realities may change that schedule.

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Further public understanding of water quality by continued analysis of DPW and MCHD data	1	The public	Update the water quality report of this plan within 3 years	$5,000-10,000	TA=Pay a consultant to go through the data	
Create awareness of habitat restoration through fish/bug ID, water monitoring events, etc	2	The public	Hold one event a year starting in year 3	<$1,000	PP=SWCD, schools TA=Someone to ID the fish and bugs	
Encourage a net zero water and waste objective	3	Churches, commercial properties, neighborhood groups	In year 3, research strategies applicable for small urban watersheds	$1,000-$2,000		
			By end of year 3, have designed and implemented education/outreach	$1,000-5,000		
Educate on proper lawn chemical application	5	The public, commercial property owners, parks and golf courses	By end of year 3, have met with maintenance staff at parks and golf courses to determine their chemical use	<$1,000	PP=SWCD, Fertilizer Retailers, Neighborhood Groups	Upper White River Watershed Alliance
			During year 4, design education specific to the needs of the target audience	$1,000-$5,000		
			By end of year 4, begin implementing education strategy	>$5,000		

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Decrease phosphorus load by promoting use of phosphate free dishwashing detergents	5	The public and retailers	By end of year 3, gather information about what P-free detergents work best and where they are sold	$1,000-$2,000	PP=Retailers	
			In year 4 and onward, urge retailers to carry P-free detergents and include information as part of 'Protect Pleasant Run' outreach	$1,000-$2,000		
Explore ways to measure flow at or near the watershed's mouth	6	City Officials	During year 3, find possible sites and determine if the city is interested in installing a gage	$5,000	PP=Indianapolis, USGS, IUPUI	
			In subsequent years, work with city to install the gage. If city lacks interest, research other 'low tech' options	USGS gage can cost over $20,000/yr		

Priority 4: Each objective is scheduled to occur during year 4-5 of implementation. Unforeseen realities may change that schedule.

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Encourage master naturalist certification programs to do projects that improve water quality	1	Gardeners	By year 4, have contacted the master naturalist program and begin learning about partnering with them	$1,000-2,000	PP=Resource Conservation & Development Councils, Indiana Soil and Water Conservation Districts, Purdue Cooperative Extension Service, Indiana Department of Natural Resources	www.in.gov/dnr/masternaturalist
			By year 5, identify master naturalist students in Indianapolis area			
			By end of year 5, have partnerships in place to do a project			
Research possibility of removing dams	2	Indianapolis, DNR, landowners along stream	By end of year 4, find dam owner	<$1,000	PP=Indianapolis TA=Engineers and consulting firms	
			By end of year 5, have studied the positives and negatives of dam removal	$5,000-$10,000		
			Hire an engineering firm if removal becomes a goal	>$10,000		

Objective	Goal(s)	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)	Existing Resources
Remove Bean Creek from underneath Harvester parking lot	2	Harvester, Indianapolis, DNR, IDEM	Complete an engineering study by year 4	>$10,000	PP= Harvester, Indianapolis, DNR, IDEM, IDO TA=Engineering firm	
			Get all necessary permits by end of year 4	>$10,000		
			Start project in year 5	>$100,000		
Advocate that savings from Long Term Control Plan Budget be used to reduce the cost of septic removal for STEP areas	4	The public and Indianapolis	In year 4, research DPW budget to learn potential saving and STEP costs. Create contacts at DPW and City Hall	$1,000-$2,000	PP=City Council, STEP participants	
			Continue to advocate until objective is reached or options exhausted	$1,000-$5,000/yr		

Figure 27: Action Register for the Goals' Indicators

Indicator	Goal	Target Audience	Milestone	Cost	Possible Partner (PP) and needed Technical Assistance (TA)
The number and type of public participation events and opportunities as well as progress towards achieving goals 2-6	1	Friends of Pleasant Run and others interested in evaluating this plan	During years 1-5, keep track of events and participants	<$1,000	PP=Volunteers to track event participation
			At end of year 5, look for increases in public participation from year 1 and success reaching indicators 2-6	$1,000	
Benthic Macroinvertebrate scores taken at MCHD's existing sites in the watershed	2	Friends of Pleasant Run and others interested in evaluating this plan	At end of year 5, download MCHD data and compare with data from this plan	<$1,000	
Monthly sampling done by DPW and MCHD at their existing sites in the watershed	3	Friends of Pleasant Run and others interested in evaluating this plan	At end of year 5, download DPW/MCHD data and compare with data from this plan	$1,000-$2,000	TA=Person familiar with water quality data and spreadsheets
Monthly sampling done by DPW at their existing sites in the watershed	4	Friends of Pleasant Run and others interested in evaluating this plan	At end of year 5, download DPW data and compare with data from this plan	$1,000-$2,000	TA=Person familiar with water quality data and spreadsheets
STEPL modeling that factors Total Phosphorus reductions from installed BMPs	5	Friends of Pleasant Run and others interested in evaluating this plan	During years 1-5 model load reductions from all BMPs	$2,000-$3,000	TA=Person familiar with STEPL or willing to learn
			At end of year 5, compare modeled data with needed reductions	<$1,000	
The sum of the storm water infiltrated from the practices installed as part or in support of this project	6	Friends of Pleasant Run and others interested in evaluating this plan	During years 1-5, track estimated infiltration from all BMPs	$2,000-$3,000	
			At end of year 5, compare estimated infiltration with needed reductions	<$1,000	

9.1: Future Activity

Friends of Pleasant Run's short term goal is to find funding in order to start implementing the plan. Though Friends of Pleasant Run completed this watershed plan, our hope is that we are not the only organization to put it to use. Even before the plan was finalized, Keep Indianapolis Beautiful was using the buffer maps to generate ideas on their future projects. We hope other organizations and municipalities follow that lead. Whoever uses this plan is responsible for ensuring that the information within is still accurate. The features of a watershed continually change, as should a watershed plan. Updating the Pleasant Run Watershed Plan every five years is the responsibility of those using the plan and the community as a whole.

For more information, please contact Friends of Pleasant Run.

www.pleasantrunwatershed.org

pleasantrunwatershed@gmail.com

Glossary

Benthic Macroinvertebrates—Aquatic animals large enough to be seen with the naked eye that lack a backbone and live primarily on the bottom of streams.

Best Management Practice (BMP)--- methods or techniques found to be the most effective and practical means in achieving an objective. Watershed BMPs typically filter runoff or help infiltrate it into the ground. Examples of BMPs are in Appendix H.

Buffer---an area of vegetation along a stream bank. Buffers filter runoff before it enters the streams. The filtering ability increases with buffer width and plants with deep root structures.

Combined Sewer Overflow (CSO)---direct outlets to streams that, when it rains, sometimes release untreated sewage. These releases occur because CSO systems use one pipe to transport sewage and storm water. Often when it rains even 0.25 inches, the pipe can't hold both the sewage and storm water, so both overflow untreated into local streams. CSOs were originally designed as a failsafe in the event of major storms, but they are old technology now and due to the increase of impervious surfaces, rain events all too often overwhelm their capacity. Pleasant Run Watershed has 55 CSOs.

Hydrologic Unit Code (HUC)---a classification system used by the United States Geological Survey to group watersheds by size. Each watershed in the country is assigned a HUC, which is a series of numerical digits. Larger watersheds have smaller HUCs.

Infiltration---the process by which water penetrates into soil from the ground surface.

Low Impact Development---an approach to land development (or re-development) that works with nature to manage storm water as close to its source as possible. LID employs site design principles such as preserving and recreating natural landscape features and minimizing land disturbance.

Nonpoint Source Pollution (NPS)—a technical term for runoff pollution. Because runoff doesn't originate from any specific place on the landscape, it is known as 'nonpoint'. The term is used to contrast it with Point Source Pollution.

Point Source Pollution---pollution that originates from a fixed point on the landscape; typically a pipe or other outlet into a waterbody. Point sources of pollution are regulated and issued permits for the amount of pollution they discharge. Factories are common point sources of pollution.

Runoff—rain or snow melt that flows off the landscape. Runoff picks up pollutants as it moves across the landscape.

Watershed—all the land that drains to a specific point on the landscape such as a stream or lake. Watersheds vary in size and are nested within each other.